



TANGANYIKA

Annual Report
of the
Department of Agriculture
1955

PART II

1956
PRINTED BY THE GOVERNMENT PRINTER
DAR ES SALAAM
Price Shs. 4/50



Annual Report
of the
Department of Agriculture
1955

PART II

CONTENTS

	PAGE
<i>Cotton and Other Crops:</i>	
Progress Report of the Ukiriguru Agricultural Station for the Season 1954-55	1
Ilonga Research Station, Progress Report for the Season 1955 ...	20
<i>Coffee:</i>	
Coffee Research Station, Lyamungu, Moshi—Summary of the work carried out during 1955	30
Summary of the work carried out at Maruku Coffee Station, Bukoba, 1955... ..	36
Summary of the Annual Report of the Mbosi Coffee Sub-Station, Southern Highlands Province, 1955... ..	37
<i>Entomology:</i>	
Annual Report of the Entomologist, Morogoro, 1955	38
Annual Report of the Entomologist, Lyamungu, 1955	43
<i>Plant Pathology:</i>	
Annual Report of the Plant Pathologist, Lyamungu, 1955	47
Annual Report of the Plant Pathologist, Arusha, 1955	49
<i>Botany:</i>	
Annual Report of the Botanist, Ukiriguru for the Season 1954-55 ..	54
<i>Field Experiments:</i>	
Report of the Agricultural Officer (Experiments), Njombe, Southern Highlands Province for 1955	60
Report of the Agricultural Officer (Coast Agricultural Station), Chambezi, 1955	77
Report of the Agricultural Officer (Mwanhala Experimental Station), Western Province, 1955	81
Report of the Agricultural Officer (Mahiwa Experimental Station), Southern Province, 1955	83
Summary of Experimental Work, Lake Province, 1955	84
Notes on Experiments carried out in the Northern Province, 1955 ...	88
Notes on Experiments carried out in the Tanga Province, 1955 ...	92

PROGRESS REPORT OF THE UKIRIGURU AGRICULTURAL STATION FOR THE SEASON 1954-55

COTTON SEASON

Planting:

Ukiriguru, 1st December, 1954 to January, 1955;
Lubaga, mid-December, 1954 to January, 1955;
Cultivators, mainly January to late February, 1955.

Picking:

May until August, 1955.

Legal uprooting date:

14th September, 1955.

Rainfall for the period 1st October, 1954 to 30th June, 1955:

Ukiriguru: 22.65 inches;
Lubaga: 22.36 inches.

INTRODUCTION

By J. E. PEAT

UKIRIGURU STATION

Rainfall: 1954-55 was dry with drought periods in the first half of March and again in late April into early May. Rains shut off in mid May on the early side but not exceptionally so. The general distribution was better than in 1953/54. The November-December planting rains were patchy; it was possible to plant at Ukiriguru but many of the cultivators waiting for more steady planting rains had their planting delayed.

At Lubaga the rainfall in January was less than at Ukiriguru and with a more difficult distribution.

STAFF

Mr. J. E. Peat was on vacation leave from the 8th May until the 8th August, 1955.

Mr. J. M. Munro was transferred to Nyasaland, leaving Ukiriguru on the 29th September, 1955. He had served nearly six years at Ukiriguru. His services have been greatly appreciated, more especially in the critical examination of records. He has played an important part in much of the work set out in this report.

Mr. K. J. Brown arrived at Ukiriguru on posting on the 15th July, 1955.

Mrs. M. H. Arnold (Dr. K. M. Russell) started part-time duties at the end of October.

Mr. R. A. Brown, Field Officer (Agriculture), Farm Manager, proceeded on vacation leave on the 21st March and returned to duty on the 6th October, 1955. His relief was Mr. B. J. Lumby, Field Officer (Agriculture) who served at Ukiriguru from the 3rd March to the 18th October, 1955.

Mr. A. D. P. Angelini, Field Officer (Agriculture) went on vacation leave on the 12th May, 1955, and is not being posted again to Ukiriguru.

Mr. I. S. Mkwawa, Assistant Agricultural Officer, returned to Ukiriguru on posting on the 14th July, 1955.

VISITORS

His Excellency the Governor, Sir Edward Twining, visited Ukiriguru in November to congratulate the staff on the part they had played in exceeding the target of 100,000 bales in the Lake Province.

LAKE PROVINCE COTTON

The 1954/55 baleage is by far and away the largest produced in the Lake Province. At present the estimate, based partly on seed cotton bought, is 107,650 bales, over 16,000 bales more than the previous record production of 1953-54. The acreage recorded as planted is high, 301,230 acres, but the provincial yield per 100 acres planted is lower than in the previous three years—roughly 36 bales per 100 acres compared with an average of 42 bales per 100 acres for the previous three years. As will be mentioned later a fair part of this loss might reasonably be attributed to the amount of cotton late planted. (Planting before the end of December, certainly before mid January, is recommended). One hundred and seventy-five thousand cultivators grew cotton, planting each an average of 1.7 acres. (Figures from the Assistant Director of Agriculture, Mwanza).

In only one of the marginal fringe areas, mentioned in the 1953-54 report, was cotton growing successful. Pest damage in these areas caused heavy loss.

Given a maintained acreage and a continued interest by the cultivators, it should be possible to raise the Lake Province production above the 1954-55 record figure.

This 1955-56 planting season has been good, though the November/early December planting rains were patchy. A record demand for cotton seed for planting is reported.

SUMMARY OF THE MAIN RESULTS AND PROGRESS

At Ukiriguru the husbandry results are generally very satisfactory. There is continuing profit from land resting, from manuring with cattle manure, and from the use of phosphate. There are striking results from top-dressing sulphate of ammonia on cotton. In one trial a very high first residual response to organic manure was recorded. A very interesting result was the increased seed cotton production obtained where phosphate was added to land previously cropped with millet undersown, with cowpeas, with a mixture of *Crotalaria* sp. and *Tephrosia* sp., or where previously cropped with velvet beans.

Throughout, the manurial and land resting results indicate the balance that is needed in farming the hill sands, between the phosphate requirement particularly—though probably other plant nutrients are also concerned—and nitrogen.

A UK. 55 was constituted and issued for multiplication on Kome Island.

UK. 48 and UK. 51, in trials at Ukiriguru, Lubaga, and district plots, gave from 75 lb. to 132 lb. of lint per acre increase over MZ. 561.

O/334 and 1/667, the constituents of UK. 55, have yielded better than UK. 48 and UK. 51 in these trials.

The work on the Albar 51 crossing programme has reached the stage when third backcross segregates are being studied.

The B₂B_{6m} programme continues.

Nearly all the seed issued to cultivators was treated with Perenox. Serious bacterial blight was rare.

Pest damage in the province was reasonable. Again, as in the previous two years, there were considerable populations of American bollworm on Ukiriguru, attacking maize and sorghum, very little attack on cotton was evident.

GENERAL ACCOUNT OF THE WORK FOR THE SEASON

By J. E. PEAT AND K. J. BROWN

HUSBANDRY

Each season the picture becomes clearer how the productivity of these granitic areas could be raised considerably if the agronomic results obtained at Ukiriguru could be used in general agricultural practice by the African cultivators. Compared to most other parts of Africa these hill sand areas are particularly fortunate in that the responses can be obtained relatively simply. It is worth considerable effort to get over to the growers the possibilities for improvement opened up by these agronomic results. There are large responses to cattle manure, to the use of phosphate, to the use of sulphate of ammonia, to land resting and to tie-ridging.

Two points should be made. Firstly, most of the responses have been measured with cotton as the indicator crop, measured by the weight of seed cotton picked. Under some conditions cotton responds differently from bulrush millet, the grain indicator crop, having somewhat different nutrient requirements, and with a different cropping period. But over the range of experiments and over the years the general story is the same, with a larger profit to cotton. Secondly, reactions have to be studied over the years. The drought period in 1953-54 prevented profit, as measured in seed cotton, being obtained from top-dressings of sulphate of ammonia. The reaction to the applied nitrogen was there, but the March drought resulted in the greater wilting of the bigger sapper plants and therefore crop loss. This past season the rainfall distribution has been better, some of the responses to top-dressing nitrogen have been very good. In general the biggest increases have occurred where the land used was moderate to poor.

Time of Planting.—A simple time of planting demonstration at Ukiriguru on uniform land again showed a most marked drop in yield as a result of delayed planting. There was no obvious cross interference from pests and diseases. From planting at the beginning of December the yield was around 1,500 lb. seed cotton per acre, from planting towards the end of December the yield was not greatly reduced, around 1,250 lb. per acre, from planting just before mid-January the yield dropped to around 600 lb. per acre, and early February planting gave a yield of just over 400 lb. per acre.

It is not unreasonable to attribute the lower general level of provincial yields this past season to the high proportion of late planted cotton—mostly planted in late January, through February, even into March.

Land Resting.—Trial (6) entered its second cropping cycle this past season. Results are given in Table 1. The treatments were described in the 1950-51 report. All treatments gave approximately the same increase over control, around 300 lb. seed cotton per acre—an increase of 50 per cent. Residual responses, from the fallow variants, as well as from the compost and superphosphate applications have probably played at least a small part.

TABLE 1.—MANURIAL AND RESTING CROP TRIAL

UKIRIGURU—HILL SAND—TRIAL (6)

Six blocks (cotton) of five plots of 1/27.3 acres. Cropping rotation—three years fallow and millet: three years cotton. Compost applied 27th September, 1954 (also in 1948 and 1951). Phosphate applied 27th September, 1954 (also in 1948 and 1951).

Five-foot ridges, two rows at eighteen inches spacing, two plants per hole. Cotton planted 22nd December, 1954.

First year of the second cropping cycle						First indicator crop of the second cropping cycle Seed cotton lb./acre
A. Continuous cropping with millet in the resting cycle, cotton in the cropping cycle:						
Control	...	...	...	...	...	616
Compost—3 tons/acre	...	...	...	...	...	953
Double superphosphate—75 lb./acre	...	...	...	...	...	931
B. "Tumbledown" fallow						
Planted fallow	...	...	...	...	...	921
	...	...	...	...	...	966
Sign. Diff. (P=.05)...	...	...	...	...	...	125
S.E. ...	...	...	...	...	...	±42.5

Third indicator crops, cotton and bulrush millet, were grown in Trial (7) (Table 1 in the 1953-54 report). The controls, in the eighth year of cropping, rotated cotton and millet, were 971 lb. seed cotton per acre, and 695 lb. bulrush millet per acre. In the cotton section, treatments were still all significantly up on the control, but no one treatment gave responses significantly greater than the others. Some of the bulrush millet treatment increases were not significant, and there were inconsistencies. The highest bulrush millet response was the second residual response following the compost application in 1952-53 of six tons per acre, an increase of 285 lb. bulrush millet per acre.

Further to the trials including three-year resting periods and a trial including a five-year resting period, an important new series with one-year resting periods has been started. The results from the first are given in Table 2, Trial (31). (In fact the "tumbledown" fallow resting period amounts to about fifteen months as the preceding crop of grain would have been off by July and the indicator cotton is not planted until November-December of the following year). The trial is divided into three sections, treatments with no phosphate, treatments where the phosphate at 90 lb. per acre double superphosphate was applied to allow the treatments themselves to benefit from the application, and treatments where the phosphate was applied just prior to the planting of the indicator crop, cotton. It will be seen that without phosphate being applied, the only worthwhile treatment response was following the one year "tumbledown" fallow, an increase of 183 lb. seed cotton per acre over control—not quite significant. Phosphate applied to the control plots showed only a moderate response, and there was still less response to phosphate applied to the "tumbledown" fallow plots. But there were striking increases in the variants where legumes had featured in the one year treatment; especially was this so following the one year growing of velvet beans. The assumption is that the nitrogen, made available presumably by nodulating legumes, could not be utilized in the absence of sufficient phosphate. This trial is being continued for a second year to measure any residual effects; a similar trial is under its first indicator crop this present season; and a third similar trial is being established.

TABLE 2.—ONE YEAR FALLOW EXPERIMENT

UKIRIGURU—HILL SAND—TRIAL (31)

Four blocks of 5 × 3 factorial, plots each 1/48·4 acres. Cropping rotation—one year fallow, or cropped treatments. Cotton the indicator crop. Phosphate applied 4th February, 1954 and 13th November, 1954.

Five-foot ridges, two rows at eighteen inches spacing, two plants per hole. Cotton planted 30th November, 1954.

Phosphate dressing—90 lb. double superphosphate/acre.

Mean yields: Seed cotton in lb./acre.

Treatments	First indicator crop		
	No phosphate	Phosphate Feb. 1954	Phosphate Nov. 1954
Control	584	710	643
Millet undersown with Cowpeas	592	878	949
Millet undersown with Tephrosia and Crotalaria ...	590	974	790
Velvet beans	618	1,114	979
"Tumbledown" fallow	767	786	888
Sign. Diff. of treatments		189	
S.E.		± 66	

Manuring and Fertilizers.—Results from Trial (8), discussed in previous reports, are set out in Table 3. In the first section the responses are from the tenth residual crop—the eleventh indicator crop. The results are similar to those recorded in previous years. Residual responses from the lighter dressings are no longer apparent. Responses from the heavier dressing of farmyard manure and from the heavy dressing of cotton seed ash are still significant. The second residual responses from the re-applied dressings are of the order that would be expected. Again the striking result is the effect of applying sulphate of ammonia to the cotton seed ash plots, compared with a similar application to the control plots.

TABLE 3.—MANURIAL TRIAL

UKIRIGURU—HILL SAND—TRIAL (8)

Eight blocks of six plots, treatments applied in November, 1944. Half plots, each 1/35·6 acres, were manured at the same rates in November, 1952, or received sulphate of ammonia at 175 lb./acre in March, 1953, 1954 and 1955.

Five-foot ridges, two rows at eighteen inches spacing, two plants per hole. Cotton planted 1st December, 1954.

Treatments	Yield of seed cotton in lb./acre		
	Eleventh indicator crop	Third indicator crop	Yearly applications
	Treatments applied 1944	Treatments re-applied 1952	S/Ammonia applied 1953, 1954 and 1955
Control—no manure	480	—	508
Compost—3 tons/acre	401	584	—
Farmyard manure—3 tons/acre	519	665	—
Compost—7 tons/acre	619	701	—
Farmyard manure—7 tons/acre	682	977	—
Cotton seed ash—1½ tons/acre	729	—	1,238
S.E.	± 57	± 62	± 62
Sign. Diff. (P=0.05)—			
in the same column	164	177	177
in the same line		156	
not in the same line or column		176	
Interaction: Ash×Nitrogen		+ 236	± 44.5

In Trial (38), started this past season to try to get response curves, with four rates of double superphosphate, and four rates of sulphate of ammonia, no worthwhile responses were obtained. Differences were not significant; but the level of fertility was high. The control yield was 1,230 lb. seed cotton per acre.

At Lubaga all that appears to be worth doing on the “ibushi” and “ibambasi” soils is to prevent the soil from eroding away, and, as will be mentioned later, cropping on tied-ridges instead of flat cultivation. None of the rotation or resting treatments tested there has produced any worthwhile results, while the profit from tie-ridging compared to flat cultivation is generally considerable.

At Ukiriguru the rotation trial, Trial (19), has been discontinued. Again this past season there were no worthwhile results contrasting continuous cropping with cotton and bulrush millet, with one and one rotation, one and two rotation, and two and two rotation. The past three seasons have not shown cotton trash bacterial blight infection, which in the wet 1951-52 season was suspected to be the main factor in reducing yields where cotton was grown continuously or every second year. This aspect is being studied in direct bacterial blight work.

Trial (9), Table 4, was described in the 1953-54 report. This year the second indicator crop of this manuring cycle was grown, 200 lb. of sulphate of ammonia was applied to the portion receiving nitrogen. The responses to organic (residual) and nitrogen (direct), are very striking. The control mean was 879 lb. seed cotton per acre. Plants in the control plots were small but cropped effectively.

TABLE 4.—NPD EXPERIMENT

UKIRIGURU—HILL SAND—TRIAL (9)

2×3×2 factorial with NPD and ND interactions partially confounded, testing all combinations of:—

n₀, ... n₁ 0, 200 lb. sulphate of ammonia/acre.
d₀, ... d₁ 0, 6 tons compost/acre.
p₀, ... p₁, ... p₂ ... 0, 75, 150 lb. double superphosphate/acre.

Six replications in twelve blocks of six plots, each 1/69·7 acres. Compost and phosphate applied 15th and 16th September, 1953. Nitrogen applied 23rd February, 1955. Cotton planted 3rd December, 1954.

FIRST RESIDUAL YEAR—NITROGEN RE-APPLIED

Mean yields: Seed cotton lb./acre.

	(1)	d	n	nd
P ₀	879	1,635	1,404	1,831
P ₁	917	1,644	1,629	2,042
P ₂	1,078	1,764	1,776	2,154
Sign. Diff. (P=·05)			250	
S.E.			±88	

The first residual phosphate response is of the order expected. But by contrast the organic first residual response, 756 lb. seed cotton per acre, is very high, higher than anything previously recorded, causing a reiteration of the query, wherein lies the residual organic manurial effect? The application of 200 lb. of sulphate of ammonia on the controls has given a mean increase of 525 lb. seed cotton per acre—also very high and much higher than anything previously recorded. In Trial (26) there is in the control plots a response of 260 lb. seed cotton per acre to the application of 200 lb. of sulphate of ammonia per acre. To these two results contrast Trial (8) where in the last two seasons there has been no response to the application of sulphate of ammonia to the controls. In Trial (9) 200 lb. sulphate of ammonia applied to the first residual p₂ plots, gave an increase over the mean control of 897 lb. seed cotton per acre, a doubling of the control yield. The highest yield, 2,154 lb. seed cotton per acre, comes from the first residual organic plots plus p₂, top-dressed with nitrogen. There is a negative interaction between compost and nitrogen, and a positive interaction between phosphate and nitrogen.

In Trial (26), Table 5, are set out the second residual results, third indicator crop, from applications of compost and phosphate made in 1952, with nitrogen applied at four rates this past year. This experiment, but with nitrogen applied at different times instead of different rates, is described in the 1953-54 report. The residual responses and the nitrogen responses are satisfactory, with the mean control yielding just over 800 lb. seed cotton per acre.

TABLE 5.—NPD EXPERIMENT

UKIRIGURU—HILL SAND—TRIAL (26)

Five replications of 2×2 factorial, with split plots of 1/69·7 acres giving four nitrogen treatments. Compost and phosphate applied 29th November, 1952. Sulphate of ammonia applied 24th February, 1955, at flowering.

Five-foot ridges, two rows at eighteen inches spacing, two plants per hole. Cotton planted 16th December, 1954.

p ₀ , ... p ₁	0, 150 lb. double superphosphate/acre.
d ₀ , ... d ₁	0, 6 tons compost/acre.
n ₀ , ... n ₁ , ... n ₂ , ... n ₃ ...	0, 50, 100, 200 lb. sulphate of ammonia/acre.

SECOND RESIDUAL YEAR—NITROGEN RE-APPLIED

Mean yields: Seed cotton in lb./acre.

Nitrogen treatments	Third indicator crop from dressings of compost and phosphate				Nitrogen Means
	(1)	d	p	pd	
No nitrogen	813	1,111	995	1,259	1,045
50 lb./acre... ..	903	1,354	1,293	1,340	1,223
100 lb./acre	1,008	1,279	1,340	1,623	1,313
200 lb./acre	1,073	1,184	1,282	1,614	1,288
Sign. Diff. (P=.05)—					
in same column			209		105
in different columns			359		S.E. ±36.9
P and D means	950	1,233	1,228	1,460	
Sign. Diff. (P=.05)... ..			301		
Main effects:					
	P + 253				
	D + 257	S.E. ±97.7			
	PD — 26				

Ridge Tying.—In Ukiriguru Trial (16), Table 6, poor ridges not tied compared with good ridges tied, the results are generally similar to those obtained in the last years, an increase of 315 lb. seed cotton per acre as a result of good ridges tied—1,150 lb. to 1,465 lb. For the bulrush millet section there is an increase of 220 lb.—804 lb. to 1,024 lb.

TABLE 6.—RIDGE TYING TRIAL

UKIRIGURU—HILL SAND—TRIAL (16)

Ten blocks (five cotton, five millet) of four plots 1/29.0 acre. Cropping rotation—cotton and millet alternate, every year.

Five-foot ridges, two rows at eighteen inches spacing two plants per hole. Planted 30th November, 1954 (cotton); 10th January, 1955 (millet).

Nine years treatments 1946-47 to 1954-55	Mean yields: lb./acre	
	Seed Cotton	Millet Grain
Poor ridges not tied	1,150	804
Good ridges tied	1,465	1,024
Sign. Diff. (P=.05)	124	113
S.E.	±39	±35

In a second Ukiriguru tie-ridging trial stands were exceedingly irregular, and no profit appeared from the tying. There was a substantial increase from the sections that had been manured compared to the non-manured.

At Lubaga there were responses, similar to those recorded for the last few years, to ridge tying compared to flat cultivation, more particularly with cotton. On the "ibambasi" (hard pan soil) cotton on the flat yielded 330 lb. seed cotton per acre; the 3-feet tied ridges yielded 711 lb. seed cotton per acre; and 4-feet tied ridges 673 lb. seed cotton per acre. The sorghum portion of the trial did not show significant responses. In an "ibushi" (dark old lake bed soil) trial, cotton showed a non-significant increase of about 60 per cent, for 3-feet and 4-feet ridges tied compared to flat cultivation, the flat cultivation yielding 473 lb. seed cotton per acre. In another trial the yield from flat cultivation was 266 lb., 3-feet and 4-feet

ridges tied gave an average of 660 lb. seed cotton per acre, more than a doubling of the crop, with no significant difference between the 3-feet and the 4-feet ridges. In the sorghum section of this trial flat cultivation yielded 788 lb. sorghum per acre. There was no significant difference between the 3-feet and 4-feet ridges tied which yielded an average of 1,127 lb. per acre, an increase of over 40 per cent.

COTTON BREEDING

There are three cotton breeding programmes in being at Ukiriguru; a continuation of the original programme, sorting out segregates in the Mwanza "Local" material; the sorting out of segregates in the Albar 51 programme of adding resistance to bacterial blight to the best of the Ukiriguru strains; and a third programme adding bacterial blight resistance by crossing BAR 14/38 (B₂B_{6m} Sakel), to the best Ukiriguru strains. These two programmes of adding bacterial blight resistance, are discussed under the section "Bacterial Blight".

This past season, the Lake shore general area was under UK. 51, with UK. 48 in inland areas. For 1955/56 the provincial crop is all UK. 51, except for a small multiplication on Kome Island of the new UK. 55.

As mentioned last year, with the range of peasant growing conditions, it is difficult to estimate what the contribution of these two seed issues UK 48 and UK. 51 has been to the past season's record crop. In the main trial at Ukiriguru, where UK. 48 and UK. 51 had a mean yield of 544 lb. lint per acre, they yielded 132 lb. of lint per acre more than MZ. 561, plus 32 per cent. At Lubaga, where their mean yield was 143 lb. lint per acre, they yielded 88 lb. of lint per acre more than MZ. 561. In nine of the most uniform district plots scattered over the province, not necessarily the highest yielders, but incidentally giving a mean for UK. 48 and UK. 51 of 418 lb. lint per acre, just over a bale an acre, they yielded 75 lb. of lint per acre more than MZ. 561, plus 22 per cent. This is a satisfactory record and shows the improvement in production that the issue of these strains can effect with reasonable husbandry and timely planting. It should be noted that the nine district plots are peasant cultivated.

Considering the Ukiriguru main trial, two of the leading members of the 8/290 family, 0/334 and 1/667, yielded 59 lb. and 55 lb. lint per acre more than the mean of UK. 48 and UK. 51—around 46 per cent up on MZ.561. At Lubaga, with comparatively low yields, they were 27 lb. and 115 lb. lint per acre better than the mean of UK. 51 and UK. 48; and over the nine district plots 45 lb. and 41 lb. of lint better—34 per cent up on MZ. 561.

The new UK. 55 consists of 50 per cent each of 0/334 and 1/667. Several members of the 5/57 and the 6/318 families still continue as possibles; though for a number of reasons a mixture of 0/334 and 1/667 was considered the safest issue.

Two U4×Sea Island crosses, 1/685 and 1/686, are amongst the top yielders.

0/457 is the best continuing member of the 7/367 family ex. L. 4/112, originally selected at Lubaga out of MZ. 457, members of which are doing well at Namulonge. In the Lake Province 0/457 is not in the top class; possibly the very qualities of free flowering which may favour it in Uganda are not favourable qualities under the harder Lake Province conditions.

TABLE 7.—VARIETY TRIALS

Yield of lint in lb./acre.

Family	Strain	Ukiriguru Main Variety Trial	Lubaga	Mean of 9 District Plots
	MZ. 561	412	45	343
	Control { UK. 48	549	113	409
	{ UK. 51	539	153	426
	UK. 48 ex Malampaka Ginnery	517	111	—
	UK. 51 ex Buchosa Ginnery	547	144	—
	Potential UK. 55 (50 per cent 1/667 and 50 per cent 0/334)	591	288	—
8/290 (ex 6/320)	0/328	653	198	454
	0/334	595	260	463
	1/667	599	248	459
7/367 (ex L.4/112)	0/457	527	143	412
Sea Island ex U4.	1/685	581	231	446
	1/686	553	215	417
Sign. Diff. (P=·05)...		56	37	
S.E.		± 24·3	± 13·2	

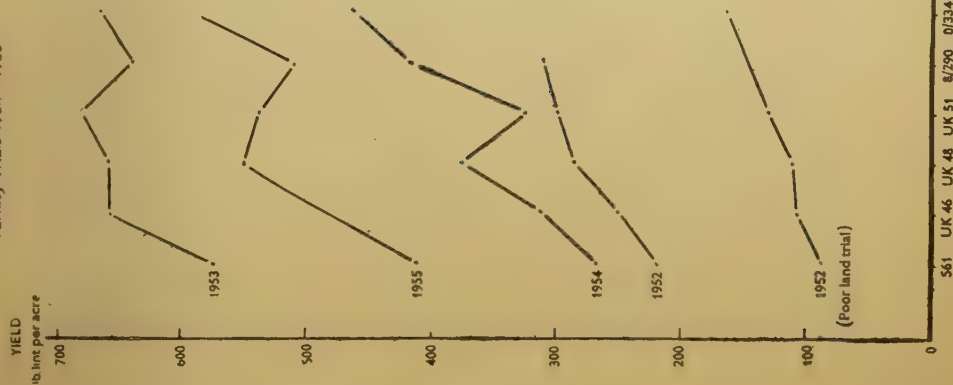
The general story this year is that the greatest yield increases between strains have shown up in the inland comparisons rather than in the better grown Lake shore comparisons. This is not always so. Fig. 1 illustrates the comparative yields over the last four years, of MZ. 561, the seed issues, UK. 46, UK. 48 and UK. 51, 8/290 and the daughter strain 0/334, at Ukiriguru, Lubaga and Arugongo (probably the best Lake shore district plot). It will be seen that though the general story is satisfactory and the trend similar in these three areas the relative behaviour of the strains varies from year to year, making any generalization about percentage increase applicable only to the particular area for the particular year.

Straight selection in the Ukiriguru breeding material was slowed down from 1951 onwards. It was thought that a far enough stage had been reached to allow work to be concentrated on the segregating crossing programme with Albar 51, and later with the new programme with BAR 14/38. This past season dipping back into bulks of 0/334, 1/667, 1/686, 0/328 and 0/331, taking new single plant selections for reasonable cropping and leaf hair, though the general field appearance of these was reasonably uniform, examining the types of seed coat fuzz, the percentage of seed coat damage, lint index, seed weight, and ginning percentage, surprising variations were recorded, six selection generations away from MZ. 561. Single plant lots have been planted this 1955-56 season, and replicated comparisons are being made of groups of high and low seed coat nep and high and low lint index to find out the extent to which these differences are genetic, or positional in the choosing of the recorded plants. If genetic, work will have to proceed on the segregation of these characters and segregation in spinning qualities.

Seed of all lots is now examined for the percentage of seed coat damage. There are considerable variations between lots. Lots showing heavy damage are discarded; but many of the best lots for this character have other less valuable qualities. Here the value of the B.C.I.R.A. Shirley Institute tests are of special

UKIRIGURU

Variety Trials 1952 - 1955



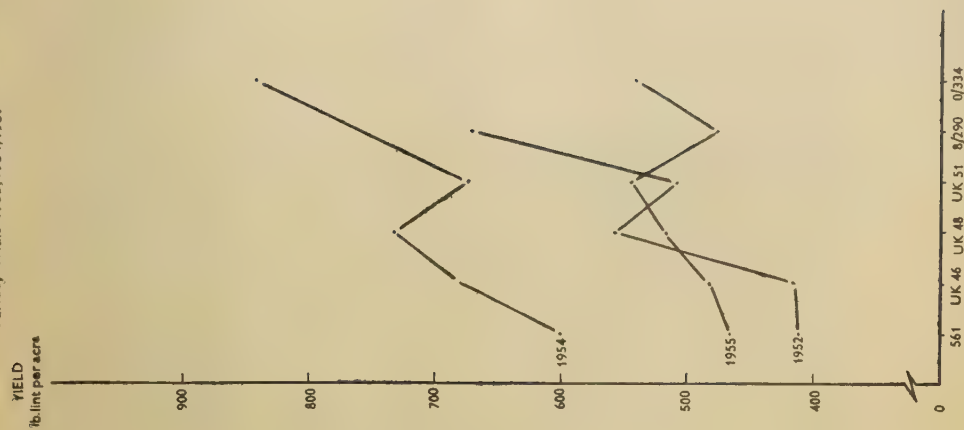
LUBAGA

Variety Trials 1952 - 1955



ARUGONGO

Variety Trials 1952, 1954, 1955



GEITA

help in assessing fibre values and spinning qualities, especially yarn appearance, in the middle group for percentage seed coat damage. The general Shirley Institute criticism of Lake Province yarn appearance is rather on differences in regularity in drawing than on excessive seed coat nep, though seed coat nep is present and is reported as more serious in some strains.

The general run of Standard Fibre Weight per cm. Shirley Institute figures in the material now being handled runs from around 175 to just over 200. It is interesting to note that a strain 0/320 ex 6/320 (from which 8/290 and the daughter strains 0/334 and 1/667 were derived), three selection generations away from MZ. 561, should suddenly show up with the entire exceptional Standard Fibre Weight of 234 resulting in a Corrected Lea Count $\times$ Strength Product of 1602 compared with 1800 to 2000 for the other lots in that testing from that particular trial. This is the only fibre test recorded for this strain.

At Ukiriguru and Lubaga, in the main variety trials, UK. 48 which had been grown at Ukiriguru each season since 1948-49, i.e. over six seasons, was compared with UK. 48 from the Malampaka Ginnery, six seasons in commercial cultivation since the original distribution. Similarly there was comparison of UK. 51 grown three seasons at Ukiriguru, with UK. 51 from Buchosa Ginnery, three seasons in commercial cultivation. It would not be said for either issue that there was evidence of mixture or deterioration in commercial growing as reflected in yield, nor was there evidence of any build-up of naked or semi-naked seeds. "Local" and MZ. 561 show about 10 per cent of naked seeds; UK. 46 1-2 per cent; UK. 48 a trace; and UK. 51 none.

BACTERIAL BLIGHT (*Xanthomonas malvacearum*)

By M. H. ARNOLD

Albar 51 Crossing Programme.—The original object of adding bacterial blight resistance to the best of the Ukiriguru strains was expanded, soon after a start had been made, to exploit the great variability which was present in the earlier progenies. To this end, material has been selected at each stage in the back-crossing progression, and continued as pedigree lines.

Selections derived from F1 and first back-cross plants, grown this season as F4's and F5's, showed a wide range of habit. Derivatives from second and third backcrosses, however, showed close resemblance to their Ukiriguru parents in both habit and Jassid resistance.

Selfed or naturally pollinated single plant progenies, which had been grown out of season, were put into trials planted in February. In these trials where the mean yield was 1,039 lb. seed cotton per acre, the yields of derivatives from third back-crosses were distributed about that of UK. 51 with none significantly higher. Of these selections, those derived from crosses made with the 8/290 family gave the best combination of high yield with high Jassid resistance. The 6/318 derivatives tended to be poor for Jassid resistance, whilst the 7/367 lines were disappointing in yield.

Some of the derivatives of first back-crosses which were included in these trials, were of outstanding habit and Jassid resistance, two yielding significantly higher than UK. 51. These lines and more recent selections made within them, will be studied closely in the coming season.

Single plant progenies were in general much more uniform than in the previous generation. The unbalanced types, to which reference has been made in previous reports, have largely disappeared in these later selections. Single plant selection

is being continued to eliminate them completely so that homozygosity for resistance may be approached as quickly as possible. This means that a large number of progenies has to be continued and it is becoming increasingly important that as much information as possible be obtained in the first year after selection. For this reason, fifteen single plant progenies have been laid aside for testing in replicated progeny rows in the coming season. The primary object of this will be to investigate the practical difficulties of the technique with a view to its much wider use if successful.

In order to obtain some estimate of the overall progress achieved by back-crossing and selection, a trial was laid down in which three Ukiriguru strains, which have been used as recurrent parents, were compared with bulked derivatives of their F₁, first back-cross and second back-cross progenies. The results, which are summarized in Table 8, show that an adequate level of yield is restored after one or two back-crosses.

TABLE 8.—ALBAR 51 BACK-CROSSING TRIAL

Design 4×4 balanced lattice. Plot size five feet×fifty feet. Spacing: two rows per ridge at eighteen inches. Planted: 7th December, 1954.

	Yield of Lint lb./acre	Increase over Albar 51
UK. 51	615	+206*
0/334 (Highest yielding strain in 1953-54)	582	+173*
Mean of two Albar 51 lines	409	0
Mean of three Ukiriguru Parental strains	577	+168*
Mean of three F ₁ derivatives	477	+ 68
Mean of three 1st back-cross derivatives	577	+168*
Mean of three 2nd back-cross derivatives	626	+217*

*Increase significant at $p < .001$.

A range of material has been carried to the fourth back-cross using as back-cross parents the strains which proved the highest yielders in the 1953-54 strain trials. The back-crossing will not be taken further for the present. The immediate objective is to obtain a better assessment of the wide range of material now being handled.

Crossing Programme with BAR 14/38.—The addition of the gene B_{6m} to a small range of the best Ukiriguru strains formed the major part of the out-of-season work. This material has now reached the first back-cross stage. The F₁ plants appeared to be immune to stem and leaf attack, and showed marked vigour.

Seed Treatment.—Yield trials, similar to trials "A" and "B" described in last season's report, were laid down on new sites. In these trials untreated seed was compared with seed treated with Perenox, Percot 45 and Agrosan GN5, applied at the rate of 1 : 300 parts by weight.

Seedlings removed from the trials as thinnings were scored for the incidence of cotyledonary infection. (These seedlings may not have been taken at random there may have been some selection of infected plants during thinning). The results are shown in Table 9. The percentage of systemic infection is shown separately because this type of infection is thought to result in greater damage to the plant than non-systemic attack.

As observed in previous trials, the mercurial dressing, Agrosan GN5, was more effective than the copper dressings, Perenox and Percot 45.

TABLE 9.—SEED TREATMENT TRIALS

Percentage of seedlings showing cotyledon lesions caused by *X. malvacearum* at 28-33 days after emergence.

	Trial "A" (7 replications)						Trial "B" (7 replications)						Booth Drum Mixer (Ten paired samples)					
	% Infection			% Systemic Infection			% Infection			% Systemic Infection			% Infection			% Systemic Infection		
	Mean	Range		Mean	Range		Mean	Range		Mean	Range		Mean	Range		Mean	Range	
Untreated ...	46.0	23-58	...	17.4	12-23	...	70.9	63-88	...	47.9	21-55	...	32.1	19-48	...	13.5	5-26	...
Perenox 1:300 w/w ...	2.7	0-7	...	1.0	0-4	...	7.0	4-10	...	3.8	0-9	...	5.0	0-11	...	0.8	0-3	...
Peresol 45, 1:300 w/w ...	3.9	0-8	...	2.6	0-7	...	4.8	1-15	...	2.0	1-3	...	—	—	...	—	—	...
Agrosan GN5, 1:300 w/w ...	0.6	0-3	...	0.3	0-2	...	0.3	0-2	...	0.2	0-1	...	—	—	...	—	—	...
Average size of sample	96						95						68					

The higher incidence of infection in Trial "B" (poorer non-rotated land) as compared with that in Trial "A", is interesting. The trials were planted on the same day, with seed from the same bulks, and the scoring was carried out over the same period. The possibility of some of the infection in Trial "B" having arisen from trash cannot be eliminated, but it is thought that soil conditions may also have been a factor. Trial "B" was planted near the "itogoro" or seepage zone of the Ukiriguru catena, whereas Trial "A" was on more typical hill sand.

In both trials, pronounced growth irregularities appeared and the yield results suffered accordingly. In Trial "A" the mean increase due to seed treatment was 20 per cent (significant at $p < .05$) and in trial "B" there was an increase of 10 per cent which was not significant. The mean yields of the "untreated" plots were 745 and 578 lb. seed cotton per acre respectively. Comparisons between individual seed treatments were of doubtful value in view of the high experimental error. The coefficients of variation which were 25 per cent and 23 per cent were probably increased by the layout employed in which each plot was separated from its neighbour by 20-foot strips of sorghum and velvet beans. These were included as barriers to the spread of infection.

All seed issued to native growers was treated with Perenox by the Department of Agriculture. Treated and untreated samples were taken at approximately weekly intervals from Malampaka Ginnery, where one of the Booth Drum Mixers was being operated. Ten such paired samples were planted and the seedlings scored for the incidence of cotyledonary infection. The results are shown on the right of Table 9.

Although there were reports of local epidemics of bacterial blight in the Province, visits to these areas revealed that in all cases the main damage was due to other causes. In extensive tours of the cotton growing areas, the only serious bacterial blight observed was in two native holdings near Ukiriguru. It was subsequently ascertained that these had been planted with untreated seed obtained from the Station ginnery.

Spread of Infection.—The spread of infection from plot to plot was investigated in an experiment in which a block of land, where cotton had not been grown for four years, was divided into 56 plots, each 30 feet square. The whole block was planted with acid delinted seed; that planted in the central two plots had been inoculated with *X. malvacearum*, and the remainder treated with Agrosan GN5, in order to give the maximum control of seed-borne infection. The seedlings at twenty-three to thirty-six days after emergence showed 64 per cent and 0.2 per cent cotyledonary infection respectively.

At seventy-seven days after emergence, scores of angular leaf spots indicated gradients of infection radiating from the main disease focus. Further scores at ninety-four days after emergence were complicated by the occurrence of "peaks" of infection which could not easily be related to the overall gradient. At this stage, the gradient was from about 3.5 infected leaves per plant at the infection focus, to less than 1.0 at the edges of the block, with scattered peaks showing up to 4.5 infected leaves per plant. (This score was based on 66 samples of 30 plants taken over half of the experiment).

The leaf infection recorded at these two stages did not develop into the more serious forms of the disease to any marked extent, and it did not appear that the plots adjacent to the infection focus suffered greater loss of crop than the more distant plots. The yields are summarized in Table 10, together with the proportions of grade "C" seed cotton.

TABLE 10.—INFLUENCE OF THE SPREAD OF INFECTION ON YIELD

	Mean yield Seed cotton lb./acre	Per Cent Grade "C" Seed cotton
Central 2 plots (inoculated seed)	1,145±86	5.2
1st ring of 10 plots (disinfected seed)	1,277±54*	6.2
2nd ring of 18 plots (disinfected seed)	1,240±39	6.9
3rd ring of 26 plots (disinfected seed)	1,310±35†	7.0

*Greater than the central 2 plots with $p < .05$

†Greater than the central 2 plots with $p < .01$

The plots grown from disinfected seed showed a mean increase of 12 per cent compared with that of the two central plots. This is comparable with the increase due to acid treating shown in a trial last season at a similar level of fertility.

Trash-borne infection.—In series of non-replicated plots on land assumed to be free from trash, comparisons were made of the incidence of bacterial blight after the application of trash at various rates and in different ways. Trash from Ilonga, where the incidence of bacterial blight is known to be slight, was included as a "control" for the possible manurial effect of large applications of trash.

Inferences from the results are of value chiefly as pointers for the design of more precise experiments. The main indicators were:—

(a) In plots where Ukiriguru trash was applied at the rate of about 1,000 lb. per acre, from 28 per cent to 90 per cent of seedlings showed leaf infection 38 days after emergence, whilst in plots where no trash was applied the average was 2.6 per cent. (The seed was acid treated).

(b) Plots where Ilonga trash was applied at the same rate, gave from 1.4 to 6.6 per cent infected plants, and 49 per cent at double the rate of application.

(c) With trash applied at a depth of about three inches along the centre of the ridge, plants on top of the ridge (whose roots grew through the trash) showed less leaf infection than plants grown on either side of the ridge.

(d) There were indications that some seed dressings applied to acid treated seed resulted in increased infection from trash.

In no case did the infection develop into serious "blackarm". Stem lesions developed only to a limited extent, and scores of their intensity at 170 days after emergence, showed no major differences between "trash" and "no trash" plots. From the yield data, it is doubtful if infection from trash had any effect on yield. The level of fertility was fairly high, the average yield being 1,165 lb. seed cotton per acre.

General.—As work on bacterial blight at Ukiriguru progresses, the complexities of the disease become increasingly apparent. Differences in conditions at the time of germination may cause great differences in the incidence of infection in seedlings grown from samples of the same bulk of seed. Infection which is first observed on leaves may spread to form severe lesions on stems and branches under one set of conditions, whereas under other conditions there may be no such development. Infection from trash appears to be important in some seasons but not in others. The marked interaction of soil fertility and the severity of the disease is frequently observed.

In spite of these complexities, and of the difficulties of field technique when dealing with a disease of this type, the results from yield trials and from "observation" plots have been consistent in showing increases in yield due to seed treatment.

The fear has been expressed that the infection remaining in plants grown from treated seed may build up to epidemic proportions and render seed treatment valueless. The rapid development of epidemics has not been observed at Ukiriguru during the past three years. In the yield trials which have been carried out, the disease could not be described as very severe even in the untreated plots.

Observations have indicated an association between cotyledonary lesions on seedlings, and the occurrence of stem lesions at the cotyledonary node later in the life of the plant. Samples of plants from various trials were scored for the incidence and severity of stem lesions, when boll opening was beginning. The lesions were graded according to the geometric series 1, 4, 9, 16, 25 where "1" represented a trace of stem lesion, and "25" a lesion serious enough to cause stem breakage. The numbers in each grade were recorded for each sample of the cotyledonary node and for the rest of the main stem. These numbers were multiplied by their respective grades and summed for each treatment. The results expressed as "lesion-grade products per hundred plants", are shown in Table 11. These figures show that the effect of seed treatment has persisted in the region of the cotyledonary node and to a less extent for the rest of the main stem. The importance of systemic infection in relation to these stem lesions needs investigating.

TABLE 11.—STEM LESIONS

Lesions-grade products per 100 plants recorded on main stems at 128–144 days after emergence.

	Trial "A" (Means of 6 replications)				Trial "B" (Means of 6 replications)			
	Untreated	Perenox	Perenox 45	Agrosan GN5	Untreated	Perenox	Perenox 45	Agrosan GN5
Cotyledonary node ...	376	38	57	40	388	75	57	16
Rest of main stem...	670	258	544	149	928	441	704	210
Size of samples ...	34				34			

Under Lake Province conditions, where long dry spells are a feature of the climate and tend to arrest the development of epidemics, it is thought that stem lesions at the cotyledonary node may be important. In severe cases, the stem breaks at this point and the plant dies. In other cases there is damage to the stem tissues and suppression of normal growth. Adventitious shoots which arise below the cotyledonary node have seldom been observed. This is in contrast to growth higher up the plant, where axillary shoots which escape infection, can often be seen growing from the node immediately below a stem lesion. Hence it would appear that the plant which is infected later on, either from trash or by spread from a nearby plant, has a better chance of compensating for the damage than has the plant which is infected at the cotyledonary node from the seed.

Problems which need clarification are (a) the importance of systemic infection, (b) the nature of the observed suppression of growth associated with infection at the cotyledonary node, (c) the precise conditions which cause epidemics, and (d) the frequency with which such conditions occur in the Lake Province.

Wilt (Fusarium oxysporum f. vasinfectum).—Wilt occurred again in the same area of Geita District in which it was discovered last year. It did not appear to be spreading.

PESTS

By J. E. PEAT

American Bollworm.—As in 1953 and 1954, from mid-February through until the beginning of May, on Ukiriguru there were considerable to very large populations of American bollworm present on the Botanist's sorghum, more particularly observed on protected bagged heads, up to several larvæ to one bagged head, and in trap plantings of maize, on these varying around 70 to 100 American bollworms per 100 plants. In spite of this American bollworm attack on cotton was quite unimportant, though 4,000 to 6,000 flared squares per acre was reported from one area of the Station at the beginning of March. Sorghum and maize flowering seem to be more attractive to the egg-laying moths, even where cotton nearby is flowering freely. The presence of these large populations on sorghum and maize illustrates the delicacy of the balance between the attractiveness of these crops and cotton; an upset in this balance could cause heavy loss to cotton as has happened in some years. In the last three years the maize trap plantings and the sorghum plantings have taken the egg-laying. Nowhere in the province was heavy American bollworm attack on cotton reported.

Jassid.—Jassid was unimportant in the damage that it caused. Only occasionally was slight damage reported.

Stainers.—On the whole stainer damage was not important. At Lubaga, populations were late in building up, but the percentage of grade "C" there in the main variety trial was 46 per cent. In the main Kwimba District plot trial the percentage of grade "C" was 35 per cent, possibly linked with kapok trees in the area. At Ukiriguru the percentage of grade "C" was around 10 per cent. In most of the district plots the percentage was under 10 per cent, in many as low as 3 per cent to 5 per cent. Again, the percentages of grade "C" are taken as indicators of the amount of stainer and *Callidea* damage. In general this is probably so, but bacterial boll rot must also be a factor.

In marginal areas outside the established main cotton region of the south-east Lake Province, e.g. North Mara and Kahama, stainer damage was reported as crippling; and this, together with bollworm losses, made cotton growing very unattractive in spite sometimes of reasonable husbandry.

Lygus.—Lygus is reported to have caused loss in Western Ukerewe Island and parts of Musoma.

Aphis. Comparatively late in the life of the cotton plant aphis was reported as locally severe in Musoma, Kwimba and Ukerewe Island, developing after the cessation of the rains in mid-May. Damage was accentuated by the amount of late planting. The blackened honeydew affected appearance had been reported as "blackarm damage".

Pink Bollworm.—Pink bollworm was reported only on the Ukiriguru out-of-season bacterial blight crossing programme.

SOIL CHEMISTRY

By P. H. LE MARE

Soil analysis has been confined to a preliminary examination of the surface soil in plots of the organic manurial trial—Trial (8). Samples were taken from the top six inches of the ridge in February, 1954. On the plots which had received only the original applications of manure in 1944 there had been 10 years for the manures to become incorporated with the soil; surface samples may therefore be used with some confidence. Other plots received a reapplication of compost and farmyard manure in 1953 so that surface samples taken in 1954 are probably unreliable. Only analyses of soil from plots which had received manures in 1944 are considered below.

Phosphorus, extracted by shaking with 0.3 N HCl for 3 minutes, was as low (0.3 mg P per 100 g soil) in the plots manured in 1944 as in the plots which had never been manured. Soil in plots which had received $1\frac{1}{2}$ tons of cotton seed ash in 1944 still contained, in 1954, 2.4 mg P per 100 g soil.

Exchangeable base content (K + Ca + Mg) ranged from 1.6 m.e. per 100 g soil where 3 tons per acre of compost had been given, to 2.5 m.e. per 100 g soil where 7 tons of farmyard manure was applied in 1944. The value in the absence of manure was 1.9.

Yields of seed cotton in 1953 and of millet grain in 1954 were very closely related to the exchangeable base content of the soil for all treatments except the cotton seed ash, which gave a much higher yield, presumably due to the higher P content of the soil.

These analyses suggest that, in the hill sands, the long-term residual effects obtained from organic manure may be due to a general improvement in the nutrient status of the soil rather than to a specific increase in phosphate as has formerly been supposed.

The preliminary nature of these analyses must be emphasized. The appointment in January, 1956 of a graduate chemist from Makerere College, Mr. A. M. Kabaara, will make possible a full investigation of the chemical and physical basis for the field data, obtained over the past dozen or so years, on manuring, fallowing and ridge-tying on the hill sands at Ukiriguru.

ILONGA RESEARCH STATION PROGRESS REPORT FOR THE SEASON 1955

Planting:

February to April.

Picking:

July to December.

Legal Uprooting dates by Districts:

Kilosa District—15th November.

Bagamoyo District—15th November.

Kisarawe District—15th November.

Morogoro District (All areas except Duthumi)—15th November.

Duthumi—30th November.

Ulanga District—30th November.

Rufiji District—31st December.

METEOROLOGICAL DATA 1955

Month	TEMPERATURE (MONTHLY MEANS)		RAINFALL		REL. HUM. 8 A.M. Monthly means Percentage
	Min Degrees	Max Degrees	Monthly total Inches		
January	71.9	93.8	4.52	...	80.8
February	68.9	86.5	6.76	...	79.4
March... ..	66.3	90.6	5.35	...	72.4
April	68.4	85.9	14.86	...	77.9
May	66.3	81.9	6.74	...	79.1
June	62.4	80.0	0.54	...	80.1
July	61.3	81.7	0.55	...	75.2
August	59.1	85.2	0.25	...	70.0
September	62.1	88.7	0.03	...	64.8
October	64.6	89.5	0.17	...	65.8
November	69.7	92.3	1.05	...	67.2
December	70.8	92.1	6.72	...	70.8
			47.54		

The striking features of this season, climatically a good cotton season, has been the large increase in yields obtained from all trials by the use of insecticides, where reasonable cultivation has been practised. At Ilonga the mean yield of 15 acres of the Plant Breeder's cotton trials and bulks was 1,600 lb./seed cotton per acre, where insecticide was used and cotton early planted. Equally well tended early planted cotton, not dusted, gave a mean yield of 175 lb./seed cotton per acre, for an area of three acres. The comparative cash return for a commercial grower, would have been about £40 per acre, using insecticide, and about £4 per acre where no insecticide was used. The total cost of insecticide amounts to about £3/10/0 per acre for 10 per cent DDT, 3 per cent BHC dust.

The comparison held through the Province.

Average yield: District plot
variety trials
Dusted lb./acre seed cotton

Mvomero	764
Mkundi... ..	1,244
Duthumi	755
Kissaki	754
Mione	693
Maoga	1,356
Malinyi... ..	1,242
Mwaya	524

Generally, rainfall was good and well distributed throughout the Province, but pest attack was heavy. A considerable acreage was planted early (February and early March) but a high jassid population developed on these plants, causing serious damage—very much more than ever previously reported, an attack probably associated with early planting of considerable areas and heavy rainfall. A jassid resistant strain is urgently needed. Later, the crop was seriously damaged by American and Spiny bollworm and bolls were lost. The February plantings resulted in tall plants of rank growth, carrying little crop. Later planted cotton (April) missed the main jassid attack but was badly damaged by American and Spiny bollworms. A small late crop was picked. In the area planted to 47/10 at Duthumi, the late crop was much bigger and 47/10 as a result gave bigger yields per acre than Local. The ten district plots planted around the province gave good yields due to insecticide application, good cultivation and ample rainfall. They proved useful in instructing surrounding growers on how to grow cotton properly and they advertised the advantages of insecticide use.

Levels of cultivation and interest in cotton vary from district to district and also within each district. Bagamoyo and Mahenge were generally below the level of the other districts due to bad roads and only a recent awakening of interest in the crop. The growers in Kilosa District tend to interplant cotton with crops. The Duthumi area is probably the best cultivated with the most interested growers. Within each area the growers divide themselves into three main groups; the progressive farmer interested in the crop and the money he will derive from it; the farmer who plants a large acreage and is interested only in the money, and the farmer who plants half an acre or interplants with foodcrops and is grateful for any return at all.

Cotton growing in the Eastern Province is difficult. The difficulties are:—

1. Heavy jassid attack on early planted cotton;
2. American bollworm infestation;
3. Bad communications in some areas and a shortage of informed advisers;
4. A low level of interest by the grower.

The answers to growing the crop are shown by the yields obtained on Ilonga and district plots; they are timely planting with a jassid resistant strain, and the use of insecticide on a well tended crop. Ten African instructors are being trained annually in cotton growing on Ilonga, and the European advisory staff is being increased.

In the more easily accessible areas, next season, selected growers in each district are to be provided with insecticide and given informed instruction and close supervision on its application by Department of Agriculture staff. The results from this may give an indication of the degree of interest and the possibility of widespread use of insecticide in native gardens.

The main hope lies in the few, hard working, interested growers who are attracted and encouraged by the profit from using insecticide. If they continue to buy and use insecticides properly they may influence their less ambitious neighbours to take better care of their cotton and use insecticide.

ILONGA—GENERAL COTTON GROWING

The season has been good; the February planting rains were well distributed and continued long enough to establish the crop and enable it to withstand the twenty days drought during March. The April and May rains were heavy and

continued into June giving a longer growing season than the previous year. Little cotton was picked from the non-dusted plots but these continued flowering until the cotton was uprooted. The dusted cotton produced a good crop. Senescence occurred in late August.

TABLE I.—SPACING—TIME OF PLANTING

Two trials (one dusted with 10 per cent DDT and 3 per cent BHC weekly May and June) one not dusted, each of five blocks with ten treatments 1/110 acre per plot, 3-foot ridges.

TIED:—STRAIN 47/10					YIELDS	
Treatments					Dusted	Not dusted
Between Plants			Plants per hole		Seed cotton in lb./acre	Seed cotton in lb./acre
February	...	...	6"	...	1,579	98
	...	...	12"	...	1,782	50
	...	...	18"	...	1,623	134
	...	...	24"	...	1,498	69
	...	...	36"	...	1,554	67
March	...	...	12"	...	695	—
	...	...	24"	...	573	—
	...	...	36"	...	425	—
April	...	...	12"	...	34	—
	...	...	36"	...	11	—
Sign. Diff. (P=.05)					241	Not sign.
S.E. ...					76	—
Percentage of Grade I seed cotton					63%	50%

TRIALS ON GROWING CONDITIONS

SPACING/TIME OF PLANTING

All the relevant details are included in Table I, and help to confirm the results obtained last year, despite the onset of the heavy jassid attack this season.

In the dusted treatments, February plantings gave roughly a 1,000 lb. seed cotton per acre more than March plantings; April plantings gave negligible yields. One foot between plants, thinned to one plant per hole, gave the highest yield for all dates of planting.

The "not dusted" trials gave very poor yields. Jassid bred up on the February plantings and killed large numbers of plants in the later sowing, seriously affecting the February plantings too. Where bolls were formed they were mainly damaged by American and Spiny bollworms.

The result emphasizes the need for Jassid resistance and insecticide and shows the increases obtained by planting in February.

INTERPLANTING TRIALS

These trials were planted partly as a demonstration for native growers, partly to obtain results to show the advantages or the disadvantages of interplanting and to see how efficiently cotton could be dusted when foodcrops were interplanted between the cotton. In this case, Swaine dusters were used and gave as good protection as the Procull rotary dusters used on all the other trials and small bulk cotton plots.

The results are shown in Table II. Cotton yields only are shown as the foodcrops planted between the cotton are used by the native cultivator and no cash return is obtained from them. Again the dusted plots gave very good yields and the contrast with not dusted plots is remarkable.

TABLE II

Intercropping trial eight replications. (Four replications dusted with 10 per cent DDT and 3 per cent BHC, May and June, four replications not dusted).

Plot size 1/20 acre 3-foot ridges, tied strain 47/10.

Treatments	Yields		Yield in terms of pure stand cotton on a single acreage basis	
	Dusted	Not dusted	Dusted	Not dusted
Cotton... ..	2,500	106	2,500	106
Cotton and Maize (alternate rows)...	615	15	1,230	30
Cotton and Sorghum (alternate rows)	882	15	1,764	30
Cotton and Beans (on sides of ridges)	451	13	451	13

Cash return in terms of pure stand cotton on a single acre basis.

	Dusted		Not dusted	
	£	s. cts.	£	s. cts.
Cotton	61	5 00	2	3 00
Cotton with maize	30	1 00		13 00
Cotton with sorghum	43	0 00		13 00
Cotton with beans	11	1 00		11 00

TABLE III.—CULTIVATION TRIAL

Six blocks, twenty-seven treatments, three blocks sprayed, three blocks not sprayed. Plot size 1/145.2 acres. Strain 47/10. Yields—all treatments in lb./seed cotton per acre.

					Sprayed	Not sprayed	
<i>Time of Planting:</i>							
February	...	...	...	...	974	...	58
March	...	...	...	...	340	...	10
April	...	...	...	...	20	...	1
<i>Standard of cultivation:</i>							
Good...	...	...	...	...	611	...	44
Fair	...	...	...	...	429	...	8
Poor	...	...	...	...	295	...	17 (due to drifting spray).
<i>Type of cultivation:</i>							
Flat	...	...	...	...	538	...	21
Ridges	...	...	...	...	424	...	20
Tie ridge	...	...	...	...	372	...	28

Due to the large number of missing plots (i.e. no cotton picked from them) the results were not analyzed.

CULTIVATION TRIAL

An attempt was made to imitate the standards of cultivation of native gardens, i.e. good, indifferent, bad. Cotton was planted early and late, on the flat, the ridge and the tie-ridge. Certain treatments were clean weeded and thinned early, other treatments were allowed to remain weedy and unthinned for a considerable period. Three replications were sprayed with 10 per cent DDT and 3 per cent BHC for 10 weeks during May and June (by C.A.I.R.U. staff).

The main points from the results (Table III) are:—

1. Early planting and spraying gave the biggest increases irrespective of other factors.
2. The large differences in yield between the sprayed and not sprayed plots. Jassid and bollworm crippled the non-sprayed plots.
3. The increase in yield obtained by good cultivation compared with poor cultivation.

4. Cotton planted on the flat gave the best yield but the differences were not great and can be accounted for to a certain extent by the type of lay out, the topography of the area (almost flat land) and the heavy rainfall.
5. The incidence of blackarm in the neglected plots was much higher than anywhere else on the farm; 8 per cent of the plants being infected. Although the incidence of blackarm generally is not high, and loss of crop due to this disease is small compared to losses due to pests, its incidence will be watched carefully.

In the coming season this type of trial will be repeated with a simpler layout, mainly as a demonstration.

PLANT BREEDING

Selection and testing.—Due to the intense jassid attack, jassid resistance has become a major character in the selection programme. It has provided a distinct problem; combined with the results from variety trials on Ilonga and district plots, the selection material available can be more clearly assessed now.

The selections have been grouped into:—

- (a) Strains selected before 1951;
- (b) Strains selected in 1951;
- (c) Strains selected from 1951 material in 1953;
- (d) A wide range of types selected in 1954 and 1955 from all previously selected lots and Eastern Province Local.

Strains selected before 1951.—Twelve of the strains were kept from the previous season and tested in trials at Ilonga and district plots. None are pure lines and none of them have good jassid resistance. Some are extremely variable and will be useful as parent strains. Several were good in all other required characters, lint quality, yield, ginning percentage and seed cost damage count. None will be carried on in variety trials next year.

1951 Selections.—Thirty-four strains and two controls were included in a variety trial, 6×6 balanced lattice. Of these, jassid resistant strains, combining all the other good characters number three, and have been included in district plot trials for next year. Sixteen strains gave significantly higher yields than "Local".

1953 Selections.—Twenty-three strains with two controls were tested in a variety trial, 5×5 balanced lattice. Eight strains have all the good characters and four of these were very good in all respects. These four will be planted in district trials next season (see Table IV). This table, although the number of strains shown is small, indicates the type of progeny being obtained.

1954 Selection.—Small bulk plots of 440, 1954 selections were planted. Eighty strains have been kept for testing in variety trials next season. Selection was based mainly on jassid resistance and habit. A small compact type of plant will be the most suitable for insecticide treatment and general cultivation in this area. Previous selection of these strains, last year, was based on seed characters mainly.

1955 Selections.—Nine hundred single plant selections were made on jassid resistance and habit in the field and then tested for seed characters in the laboratory. Two hundred and eighty-three will be grown next year in small plots.

Panmixis.—All strains selected up to 1951 were mixed together and will be grown for several seasons to form a nucleus for filtering eventually. All jassid susceptible types and other plants with "bad" field characters will be rogued out annually.

TABLE IV.—CHARACTERS OF THE PARENTS AND THE TYPE OF PROGENY BEING SELECTED FROM THEM

	lb. lint/acre	G.O.T.	Percentage Seed coat damage	Adjusted Count×Strength Product from S.S.S. Tests	Jassid
Parent 51/58 ...	530	30.6	7	—	4
Progeny 53/63 ...	481	31.4	5	2075	3
64 ...	532	30.4	1	2229	3
Parent 51/61 ...	532	30.4	6	2043	2
Progeny 53/68 ...	553	30.2	5	2048	3
Parent 51/77 ...	575	29.0	7	2229	2
Progeny 53/122 ...	675	30.0	5	2402	2
128 ...	658	30.8	6	2176	2
125 ...	582	29.3	1	—	2
Parent 51/113 ...	551	29.6	12	1990	3
Progeny 53/192 ...	596	31.8	6	2029	2
193 ...	636	29.2	8	2042	1
<i>53 trial</i>					
Controls 47/10...	452	28.4	7	2129	3
Local ...	436	29.1	5	2056	2
S.E. ...	12				
Sign. Diff. (P= .05)	85				
<i>51 trial</i>					
47/10 ...	421	28.2	8	—	4
Local ...	376	30.4	6	—	3
S.E. ...	12				
Sign. Diff. (P= .05)	86				
<i>Grading</i>					
Jassid Resistant ...	...	1	Jassid Susceptible ...	...	5

Rufiji Types.—The position regarding finer lint types for the potential irrigation scheme in the Rufiji Valley is confused as the selected strains from local cottons need to be grown under the environmental conditions of the Rufiji Valley. Therefore a wide range of type has been kept. Seed has been obtained from the Rufiji ginnery and will be grown at Ilonga next year. Further selections will be obtained from this.

Nineteen strains from the Sudan, Uganda and Ukiriguru were also grown as bulks in readiness for testing in the Rufiji. No comment can be made on any of this material until it can be grown under irrigation in the Rufiji. A considerable amount of seed cotton was obtained from all the strains planted.

District plots.—Although the accuracy of the yield figures was not high, some useful information has been obtained. The main objects of the trials this year were to give a good testing to all the oldest strains throughout the Province to see to what extent variable conditions affected cotton in the various districts and to gain experience in the ability of recorders, relatively inexperienced in some cases, to dust cotton when no European supervision was available.

The strains all proved jassid susceptible and will be discarded. Variations in environmental effects were shown. There is sufficient variation to make district plots well worth while and when a strain is available for distribution throughout the Province information will also be available on its performance in each of the different cotton areas in the Province.

Seed coat damage.—Counts were made on all strains and new selections. The percentage seed coat nep was below 20 per cent in almost every case.

ENTOMOLOGY

E. W. VALENTINE

Most of the Entomologist's staff were engaged in a large scale field trial of insect pest control in local African grown cotton, so that the continuous recording of pest populations as has been done in the past was not possible. The notes on insect pests are therefore only general.

AMERICAN BOLLWORM (*HELIOTHUS ARMIGERA*)

Field Sampling.—Before the cotton season American bollworm was recorded in chick pea (*Cicer arietinum*) in November and on riverside maize in December, then through January to late February on November planted maize. There was a slight break before further records were made on maize in late March on January and February, plantings.

American bollworm entered the cotton crop relatively early some larvæ being found in mid-March; damage had reached a sufficiently high level in some areas in April for control measures to start. The highest populations were recorded through May and June, when there was also a heavy infestation in sunflower after which the level of attack fell sharply. The last record was made in mid-July.

It is expected that American bollworm will decrease in cotton at this time, and this was probably accentuated this season by the transfer to chickpea. This is a plant which will attract American bollworm at all stages of development, from soon after germination until the plants are almost completely dried. Young larvæ feed on the surface of the leaf, and the more mature larvæ on the seed pods. Spot counts showed that populations reached levels of 15–25,000 larvæ per acre, the higher number in denser growth, i.e. close spacing and heavy seed rate. Under these conditions parasitism by Tachinids was very high, and also infection by fungus (*Spicaria rileyi* (Mabul)), recorded for the first time this year. In each of several collections of several hundred larvæ up to 40 per cent had been killed by fungus. Of other larvæ not showing obvious signs of infection, kept in the laboratory, 25 to 45 per cent died from this fungus and from 6 to 30 per cent from parasitism with total mortalities from 70 to 96 per cent. Infected larvæ were also found on cotton and sorghum, but at a much lower level. Other Lepidopterous larvæ, principally *Prodenia litura* F., on chickpea and castor were attacked by the fungus.

Egg-laying by American bollworm was extensive on dwarf pigeon pea (*Cajanus indicus*) during July, but on this crop also, parasitism, mainly by *Charops* sp., and predation by hemiptera, were very high. Both the chick pea and pigeon pea were sprayed in August so that the course of the infestation could not be recorded.

Pupation Periods.—Some records were taken, but due to pressure of other work it could not be done on the same scale as in previous years. High mortalities in cultures also reduced the amount of information available. Of the small number of pupation periods measured (185) only seven exceeded 20 days, one of which extended to 40 days (from mid-July).

SPINY BOLLWORM

This pest was particularly serious throughout the whole season both on the station and in the district. It is probable that they first built up on annual *Hibiscus* and *Abutilon* spp. and entered the cotton crop in April and May. In June the infestation exceeded that of American Bollworm.

PINK BOLLWORM

No Pink bollworm was present in the early planted crop as in the previous year, but a few specimens were found in African cotton at the end of July and then later in September and October in the top crop. By this time all the station cotton had been uprooted and burnt.

STAINERS

As most of the crop was opening during July when the influx of Stainers began little damage was done by staining. Some of the later African crops, especially those near kapok and baobab trees were infested by *D. fasciatus*, resulting in staining of young bolls.

APHIDS

At no time were Aphids a serious problem. The level of infestation was low during the whole season, probably due to the continuous rain, and high humidity. These conditions seemed to favour the development of a fungus which checked any build-up. In some insecticide trials it was found unnecessary to include aphicides.

JASSID

Undoubtedly this was the most serious pest of cotton this season. Climatic conditions were favourable for a heavy infestation which was general throughout the province. Considerable damage was done to "Local" cotton which is highly susceptible.

PRODENIA

This pest is another which caused greater damage in young cotton than in previous years, at least in the environs of Kilosa.

FIELD DUSTING TRIAL

Layout.—Two quarter-acre plots in each of eighty-seven African gardens. Two eighth-acre plots in each of thirteen African gardens. One plot in each garden dusted and one left as a control. These were chosen in groups of ten near the Research Station, for convenience of operation only.

Treatment.—Eight lb. of a mixture of 10 per cent DDT and 3 per cent BHC per acre per application for a period of eight weeks, in the quarter-acre plots; and 16 lb. in the eighth-acre plots.

Duster.—Swaine hand blower, the work being done by the farmers themselves. The result of this trial was rather disappointing compared with our success on the Station, but it did provide a great deal of useful information on standards of cultivation and the effects of these on the efficiency of pest control measures.

GENERAL NOTES ON CULTIVATION

All but five of the gardens were interplanted with maize, which is general practice in this particular area, but not typical of the district as a whole. [Thus this testing was on cotton growing well below standard.] Usually maize is the

first crop planted and cotton later at 3-foot spacings in alternate rows. This season both crops were planted within a few days of each other. Ninety-three gardens were planted in the first two weeks of February, six in the second two weeks, and one at the end of March. The areas of cotton planted varied from half an acre to 20 acres, depending mainly on the area planted to maize. Sixty-five were less than 2 acres, twenty-six between 2 and 4 acres, and the remaining nine between 5 and 20 acres, with an average size of $2\frac{3}{4}$ acres.

Very few crops were well cultivated; and in fact the poor cultivation, interplanting, late thinning, and weediness throughout the whole season were mainly responsible for the low yields. It is not reasonable that convincing worthwhile results from treatments should be expected under such conditions. Early infestation by Jassid and Prodenia also cut down the potential yield, and later the heavy spiny bollworm attack was difficult to control with dusts.

Insecticide was applied from late April to mid-May when damage count reached the equivalent of 5,000 flared squares (damaged buds) per acre. This count was proportionately high, as at that stage plants were carrying few buds due to shading by maize and smothering by weeds.

The summary gives averages for eighty-one plots, the others being excluded due to lack of co-operation from growers, abandonment of gardens, and inability to fit in two full-sized plots. Thirteen eighth-acre plots were given double the standard application of insecticide.

TABLE VI

Summary of yields from 81 plots of the Field Trial 1955, in lb. seed Cotton per acre. Net increase equals Increase minus 110 lb. of seed cotton to cover the cost of insecticide (64/-)

Treated yields lb. seed cotton per acre from:	No. of plots	AVERAGE YIELDS		Increase	Net Increase	SEED COTTON FOR SALE	
		Dusted	Undusted			Weight as % of control	
40—100	5	78	32	46	—64	0	0
101—200	30	159	43	116	6	49	113.9
201—300	28	243	55	188	78	133	241.8
301—400	9	349	62	287	177	239	385.5
401—500	6	457	95	362	252	347	365.3
501—600	3	567	248	319	209	457	184.3
Average of	81	245	60	185	75	135	225.0

TABLE VII

Average yield in lb. seed cotton per acre from thirteen eighth-acre plots treated with 16lb. of a mixture of 10 per cent DDT + 3 per cent BHC per acre application for eight weeks. 220 lb. seed cotton deducted to cover cost of insecticide (128/-).

Dusted	Undusted	Increase	Net Increase	Seed cotton for sale Weight as % of control	
268	45	223	3	48	106.1

It will be noted from Table VI that although the average yield was considerably increased, and that the amount of seed cotton for sale was doubled, this was not achieved until the yields from the dusted plots exceeded 200 lb. seed cotton per acre—really a very miserable yield. This further demonstrates the fact that unless the potential yield of the crop is relatively high, dusting is hardly economical. The higher rate of application for the conditions of cotton growing described was again shown to be uneconomical.

Future extension of this work will be concentrated on those growers who take a reasonable interest in cotton growing and are prepared to cultivate to a sufficiently high standard to be assured of a profit from insect pest control.

R. SMITH,
*Plant Breeder, Empire Cotton Growing
Corporation*
and
E. W. VALENTINE,
*Entomologist, Empire Cotton Growing
Corporation*

SUMMARY OF WORK CARRIED OUT AT LYAMUNGU COFFEE STATION, MOSHI, 1955

WEATHER

The dry weather experienced at the end of 1954 continued until the first fortnight in February, 1955 when 6.07 inches of rain was recorded. This was followed by a hot dry period until the end of March. Irrigation, which had been commenced in the last quarter of 1954, was applied at intervals to some of the experiments until the rains of February, 1955. The rains of February and March amounted to 10.87 inches. The long rains started on 7th April, and were well distributed and protracted, although the total fall was slightly below the average. Small amounts fell throughout July, and it was not until early August that the long rains can be said to have ceased. In all, the long rains produced 40 inches. Instead of the overcast weather usually expected in June and July, showers followed by hot sunny periods were experienced. Virtually no effective rain fell after the first week in August until the drought was broken on 5th November. Small but effective falls then occurred at intervals throughout the month, yielding a total of 2.78 inches. Further rain in December amounted to 3.18 inches.

CROP

The main flowering occurred in late November and early December, 1954, in mid-January (as a result of irrigation), and in mid-February, 1955. During the early part of the season coffee was slow to ripen, and the harvest in the months of June and July amounted to little more than "fly" pickings. About mid-August ripening speeded up very rapidly, with the result that the main crop was harvested in a fairly short period, the peak of which was in October. Cherry representing an approximate total, including seed, of 73 tons parchment coffee, was harvested from a total cropping area of 129 acres.

STATION EXPERIMENTS—COFFEE

A.—IMPROVEMENT OF PLANTING MATERIAL

A heavy crop (about 19 cwt. of clean coffee per acre) was borne in the clonal selection trials (Experiment XVIII). The area was irrigated by furrow in January and by overhead application in September and November. In spite of the large crop they carried, the trees were in good condition at the end of the season.

Experiment IIIB, which was planted with one-year-old material in April, 1951, gave an estimated overall yield of over 15 cwt. of clean coffee per acre in 1955. This follows overall yields of 8 cwt. per acre in 1953 and 20 cwt. per acre in 1954.

In Experiment II (seedling selection trials), the recording of individual trees was continued.

Very good growth has been made in Experiment XXIV, which was planted in April, 1954, and where the seedling progeny of 28 selections are being tested. A heavy flowering in November promises a good first crop.

The variety collection was further extended by the addition of 16 new introductions.

Some 826 plants, the results of controlled cross-pollination and self-pollination of certain selections, were planted out in an Observation Plot, where their individual yields will be recorded and other characteristics observed. Provision has been made for additions to the Observation Plot as new material becomes available. In order to obtain further data on the relative performance of clones and seedlings, some of the progeny of the selfed seed was used to lay out a small trial to compare rooted cuttings, seedling progeny (selfed seed) and seedling progeny (open-pollinated seed) of the same selection. Single tree plots were used, to make the best use of the available plants. This trial has been numbered Experiment IIIC.

B.—IMPROVEMENT OF GROWING CONDITIONS

(1) *Cultural Experiments.*

Yield records were again taken for the purpose of assessing residual effects of treatments in Experiment V (Mulch, Compost and Nitrogen) and Experiment XIVA (Banana, Trash, Guinea Grass, Elephant Grass and Compost). In the case of the latter experiment, the 1955-56 season was the fourth in which these records have been obtained, and the residual effect in this season of each of the treatments is still very marked.

Experiment XIX (testing the effect of interplanted bananas in combination with cattle manure) gave a poor yield this season, after having yielded well in the previous two seasons. This experiment was not irrigated. The depressing effect of interplanted bananas is maintained, although the differences are very slight this year.

Remarkably good growth has been made in Experiment XXIII (spacing, interplanted bananas and pruning systems). As yet there is no observable decline in vigour due to the effect of competition in the closely spaced plots, and if the heavy flowering which took place in November is any indication of the 1956 crop, some striking first yields should be obtained.

A new experiment, comparing the effects of plant density (one per hole, two per hole and four per hole) in combination with three pruning systems (single stem, multiple stem and Colombian system)* was planted.

Analysis of the soils in those plots in Experiment XV (Irrigation and Mulch) to which banana trash had been applied for twelve years showed a considerable increase in potassium. To determine whether potassium is in fact responsible for the high yields obtained from the mulched plots, a trial in which the effects on yields of potash and banana trash can be compared was superimposed on four Latin squares in Experiment XVIII (Clonal selection Trials). The treatments were first applied this year, soil samples having been taken prior to the application of the treatments.

(2) *Nutritional Investigations.*

The analyses of soils and coffee leaf tissue were continued as part of a programme of regular sampling in the preliminary study of coffee nutrition. The foliar and cherry analyses are being done with the object of studying nutritional aspects of the biennial bearing cycle, the effect of mulch and irrigation treatments, and the differences in nutrition between coffee grown at the Coffee Research

*The Colombian system requires the rapid concentration of vigour into the eight or ten pairs of primary branches immediately below the capping height (6 feet). By this means a tree with an umbrella-like habit is developed at an early stage.

Station and at Lushoto. This work is to continue for two years in order to obtain an idea of the changes during the cropping cycle. Insufficient results are to hand for conclusions to be drawn as yet.

Preliminary work on the micro-nutrient status of coffee was commenced but restricted to certain small scale spray applications and leaf analyses in the study of chlorotic leaf conditions (symptoms of deficiencies, suspected to be of manganese, zinc, iron and possibly magnesium, have been observed on coffee in the Northern Province). It is proposed to expand this work in the 1956 season by the use of chelated micro-nutrient sprays, the use of pot techniques and the study of the availability of micro-elements in soils using a bio-assay method.

(3) *Pruning Experiments.*

In Experiment XXI (comparing methods of establishing the single stem system and methods of establishing the multiple stem system) the trees with single and hitherto uncapped stems were capped at 6 feet and all except the top six pairs of primaries were removed, with the intention of developing an umbrella habit in simulation of the Colombian system. This drastic preliminary treatment has obviously rendered the plants ineffective as yielders for the time being. The highest yielding treatment in Experiment XXI this year is that with two stems arising from the node 21 inches above ground level; this treatment has produced an estimated crop of approximately 25 cwt. clean coffee per acre in 1955. Where three stems have been allowed to develop from the bottom, the estimated yield is approximately 16 cwt. per acre. The change in order of performance of treatments from year to year in experiments of this sort underlines the need to continue records over a long period before their relative merits can be assessed.

The various pruning treatments were established in Experiment XXII (pruning, irrigation and mulch). It was interesting to note the diverse growth habits of the different selections planted in this trial. The first crop was recorded this year.

(4) *Miscellaneous Coffee Experiments.*

Two obsolete experiments were adapted to study the effect of some possible methods of rehabilitating areas which were declining in productivity.

In Experiment IB, two possible methods of rejuvenating old coffee by pruning are being compared with uprooting and planting new coffee (in the same position) and leaving the old coffee.

In the second trial, Experiment IXA, replanting with new plants of the same origin was the only treatment applied.

C.—PROCESSING METHODS

A coffee washing machine was imported from America. This machine is designed to remove the mucilage of freshly pulped coffee without the necessity of fermentation. Test runs carried out at this station have shown that this can be done efficiently. The principle of its operation consists of fairly violent agitation of a mass of coffee in the absence of water.

The model tested was found to be insufficiently robust in construction. Further, liquoring quality has been consistently depressed by use of the machine. Test runs at varying speeds of operation, and with various after-treatments of machine washed coffee have been carried out with a view to improving the quality of the product.

Trials of chemical methods of removing the mucilage have been continued with the intention of discovering (a) the particular factor in the liquoring classification which in previous seasons has caused the down-grading of chemically washed coffee and (b) whether any process previous to washing may be modified in such a way that chemical removal of mucilage can then be carried out without harm to the quality.

Methods of accelerating normal fermentation were also investigated. These included inoculation of batches of pulped unfermented coffee with mucilage from fermented coffee, the addition of unfermented mucilage from the washing machine and the use as an accelerator of pulp-water. The pulp-water is rich in the enzymes present in the mesocarp of the fruit. It seems to act as a good accelerator, especially after it has been stored for more than one day. In some cases the use of pulp-water completed fermentation in four hours. As much of the acceleration work was carried out in the latter half of the season, fermentation times may be unduly optimistic, and no general statement can yet be made with regard to the relative efficiency of the various treatments. Samples from all the treatments are being submitted for liquoring reports.

As a result of preliminary coffee-drying experiments in the 1954 season carried out on a laboratory-type drier with the co-operation of the National Institute of Agricultural Engineering, the apparatus is being modified for further experiments in the 1956 season. Parts of the equipment arrived too late to commence operation in the 1955 season.

NURSERIES

(a) *Cuttings*.—Material was taken for use as keys in the projected seedling selection trial on the Station.

(b) *Seedlings*.—Seed of seventy-six selections was sown for the new selection trial. From these, sixty (fifty-four previously untried and six of known performance) will be chosen to provide plants for the trial. Seed of H.66, KP.423 and N.39 was sown for a projected fertilizer trial (Experiment XXVI). Seed of seven other selections was planted for the Entomologist's plot. Five new introductions—selections in South India—were sown.

A monthly seed sowing experiment was started. The purpose of the experiment is to test the effect on germination of four methods of seed treatment.

BREEDING

Seed resulting from the crosses made in the 1953/54 season was sown in the nursery, but germination was very poor.

Further crosses were made during the 1954/55 season, but considerable difficulty in synchronization of the flowering was experienced, and fruit set was poor.

PESTS AND DISEASES

White Stem Borer (*Anthonus leuconotus*).—Coffee in the lower areas of the Station was again sprayed with Dieldrin over the bottom 18 inches of stem in March and again in November.

Antestia (*Antestia lineaticollis*).—Incidence was generally light.

Thrips (*Diarthrothrips coffeae*).—Thrips appeared in some experiments early in the year and again during the hot weather in October/November, and were controlled by spraying with D.D.T. A second spraying was necessary in a few experiments.

Leaf-miner (Leucoptera spp.).—A severe attack occurred in parts of Experiments IIIB and XVIIIA, both of which were bearing a heavy crop and were unshaded. Irrigation brought out new leaf.

Mites (Hemitarsonemus latus).—Considerable distortion of the young leaves occurred in Experiments XVIIIA and IIIB early in the year, but the pest had ceased to do damage by the end of June.

Mealy-bug (Pseudococcus filamentosus).—A serious outbreak occurred in Experiments XVIIIA and IIIB early in the year.

Green-scale (Coccus africanus and Coccus viridis).—Outbreaks of this pest occurred in various parts of the Station. Infested trees had their stems sprayed with Dieldrin to control the movement of the attendant ants; the trees themselves were then sprayed with a white oil emulsion.

Leaf Rust (Hemileia vastatrix).—Severe infection again occurred on those trees bearing a heavy crop, especially on some of the single stem trees in the clonal selection trials (Experiment XVIII), in spite of two routine copper sprayings in February/March and in June respectively. Although there was some heavy leaf-fall, defoliation was never complete and new leaf emerged towards the end of the year.

H.61—die-back.—The same tree of the clone H.61 again suffered from a peculiar form of die-back at the beginning of the year.

Die-back and general lack of vigour was also noticed in trees of the clone F.502 in an external trial, but the symptoms were somewhat different from those affecting H.61. Trees of F.502 on the Station are normal.

OFF-STATION EXPERIMENTS

The recording of off-Station selection trials continued. Very heavy yields were recorded in the Mbosho selection trial, which was planted in April, 1952. The highest individual tree recorded gave an estimated yield at a rate of nearly 43 cwt. of clean coffee per acre. The selection I/255 was again the heaviest yielder, cropping at an average overall rate of 24 cwt. per acre; those trees of this selection which are pruned on the multiple stem system yielded at the rate of 30 cwt. per acre. Several other selections produced a crop only slightly lower than this, and the average over the whole trial was nearly 18 cwt. per acre.

Seed was supplied to the Moshi Native Coffee Board for further selection trials at Kibosho.

MISCELLANEOUS EXPERIMENTS

(1) *Weed-killer trials*.—Existing trials were wound up. Results were disappointing, and the chemical control of couch grass (*Digitaria scalarum*) and nut grass (*Cyperus* spp.) in established coffee cannot at present be recommended as a practice.

Further trials with new chemicals on unplanted land infested with couch grass were laid down on the Station by an officer of the Colonial Insecticide Research Unit.

(2) *Wound dressing trials*.—Results were disappointing and none of the dressings tried was capable of sealing the wound for twelve months.

ANIMAL HUSBANDRY

Fifteen heifers and nine bullocks died from suspected Haemorrhagic Septicaemia early in the year. There were seven cases of East Coast Fever at the beginning of July.

The total milk yield for the year was 6,995.2 gallons.

VISITORS

Visitors to the Station during the year included the Member for Agriculture and Natural Resources; the Director of Agriculture; the Deputy Director of Agriculture; Dr. C. C. Webster, Chief Research Officer, Department of Agriculture, Kenya; M. Coste from the Office de la Recherche Scientifique, Paris; the Chemist and Entomologist from the Coffee Research Station, Kenya; delegates attending the Co-operative Course in Moshi; students from local schools; parties from co-operative societies in Tanganyika, Uganda and Kenya, and various planters and representatives of commercial firms.

SUMMARY OF THE WORK CARRIED OUT AT MARUKU COFFEE STATION, BUKOBA, 1955

CROP HUSBANDRY

There has been a slight improvement in the growth of bananas fertilized with NPD, NPK, and coffee husk ash in one experiment. In another applications of NPK and lime have failed to improve growth visibly. In the selection trial the growth of coffee has improved. This improvement appears to be related to deeper penetration of roots into soils slightly less infertile and perhaps with a higher moisture content.

SOIL FERTILITY

Lime and sulphate of ammonia applied in December, 1953, showed a residual response for bullrush millet.

Soil from a fertile banana-coffee site had a higher total nitrogen content, approximately 50 per cent, than that from an infertile grassland but the difference in nitrate content was very great, 160 times as much in the good as in the poor soil. Manganese, molybdenum, iron and copper improved nitrification particularly in the grassland soil. Raising the soil moisture content to a figure much higher than the usually accepted optimum for nitrification also increased the nitrate content of the soil. The effects of micro-nutrients on these soils is being studied at Rothamstead Experimental Station. It has not yet been determined which of the micro-nutrients studied are responsible for increased nitrification.

Leaf analyses of banana, coffee and immature finger millet have been carried out. From the results it appears that some of the deficiencies may be due to non-availability of the element rather than to inadequate supply. There is fairly strong evidence of deficiencies of sulphur and boron. Trials with chelates and frits applied to the soil are being carried out and with nutrient sprays applied to the leaves.

PEST CONTROL

Dieldrin is being used to control White Stem-borer of coffee which is a serious pest of coffee in the area. Spraying trials to control Coffee-berry Borer have been carried out. Endrin appears to have been the most promising material for control of this pest. Fumigators have given very satisfactory control of moles which do considerable damage.

CATTLE

The health and condition of the cattle has not been as good as usual. In April there was an outbreak of foot and mouth disease. One ox and eight calves died and the surviving calves were short of milk. Further losses occurred during the year from various diseases. Eleven oxen died from a complaint which the Veterinary Department has not yet been able to diagnose.

The assistance of the Government Chemist in the micro-nutrient studies is gratefully acknowledged.

SUMMARY OF THE ANNUAL REPORT OF THE MBOSI COFFEE SUB-STATION, SOUTHERN HIGHLANDS PROVINCE, FOR THE YEAR 1955

Rainfall distribution was better than in 1954. In early August a very severe frost killed a few trees in the lower orchard.

COFFEE

The mulch and pruning experiments are making satisfactory progress. An NPK Ca factorial experiment has been planted. An irrigation trial is being laid down. In one experiment a number of unthrifty plants were found to have bent tap roots and all showed signs of zinc deficiency.

Green scale, white stem-borer and cut-worms were controlled satisfactorily by Dieldrex. Vigorous coffee bushes suffered less from black tip and die-back than did those planted with a badly developed root system.

GENERAL

The results of a wheat variety trial were disappointing. Green manure did not improve the yield of maize. A citrus orchard has been established and all the trees have begun to bear. Rhodes grass has grown extremely well.

ANNUAL REPORT OF THE ENTOMOLOGIST, MOROGORO, FOR THE YEAR 1955

STAFF AND STAFF MOVEMENTS

The writer has been on duty throughout the year at Morogoro. Mrs. C. A. Wyatt, Temporary Entomologist's Assistant, resigned in March and was not replaced and the African instructor strength was reduced from five to four. Mr. Salim Mwoga, gardener, who has been employed continuously by the laboratory since January, 1922, retired at the end of the year.

A meeting of the Inter-Territorial Specialist Insecticide and Entomological Committee was attended in Nairobi in November and another meeting in Dar es Salaam to lay down a programme of aerial spraying and field observations on the control of the Coreid bug, *Pseudotheraptus wayi* sp. n., on Mafia island was attended in December.

INVESTIGATIONS

Cashew.—Detailed life-history studies which have given the duration of all stages have been made on the Mirid bugs *Helopeltis anacardii* Miller and *H. bergrothi* Reut. which are responsible for stem die-back and death of young nuts. The egg stage in June and July at Bagamoyo required an average of 15.2 days and 16.1 days respectively for each species whilst the stages 1st. instar nymph to adult occupied 17.5 days and 23.1 days respectively. Field observations indicated the preference of both species for young, rather than old, trees and that young trees of a uniform age growing together in large numbers in a plantation are likely to be much more heavily attacked than the same-aged trees present in African peasant holdings where young and old trees occur together in random distribution.

Control of both species of *Helopeltis* on two varieties of two year old trees with dusts containing 0.5 per cent gamma BHC and 5 per cent DDT has been investigated at the Coast Agricultural Station, Chambezi, Bagamoyo. In one experiment five applications of 0.5 per cent gamma BHC dust was compared with eight applications throughout the growing season. Rates of application averaged 18 lb. per acre. In another, fourteen applications of a 5 per cent DDT dust and a 0.5 per cent gamma BHC dust were compared. Apart from the varietal and treatment differences the main difference between the two experiments was that the Zanzibar cashew suffered from severe water logging at the beginning of the season and in consequence had a delayed but shortened growth period which prevented the build-up of large *Helopeltis* populations, whilst the Portuguese East Africa cashew, being on a well-drained site, suffered no such set-back, had a normal growth period and was heavily attacked by the insects. Considerable cross-infestation from untreated to treated plots and from the adjacent undusted 6-acre block occurred in the experiment with the Portuguese East Africa variety. The results of both experiments are given in Tables I and II.

TABLE I

THE EFFECT OF DUSTING WITH 0.5% GAMMA BHC DUST AGAINST HELOPELTIS SPP. ON TWO YEAR OLD CASHEW, VARIETY PORTUGUESE EAST AFRICA, CHAMBEZI, 1955

Number of applications and cost throughout season	*Percentage damage to flowering shoots 120 days after beginning of dusting	Percentage of flowering branches bearing nuts 120 days after beginning of dusting	Crop yield in lb./acre	Loss per acre in Shs. dusted v. Control based on end of year price of Sh. 1 - per kilo of nuts
0	98.4	0.7	21.5	—
5 (Shs. 33/-)...	68.9	17.3	42.9	30/08
8 (Shs. 52/80) ...	42.7	44.7	107.9	14/40

*Based on damage scored, clean=0, light=1, moderate=2, heavy=3.

TABLE II

THE EFFECT OF DUSTING WITH 5% DDT AND 0.5% GAMMA BHC DUSTS AGAINST HELOPELTIS SPP. ON TWO YEAR OLD CASHEW, VARIETY ZANZIBAR, CHAMBEZI, 1955

Insecticide	Number applications and cost/acre throughout growing season	*Percentage damage to flowering shoots 79 days after beginning of dusting	Percentage of flowering branches bearing nuts 79 days after beginning of dusting	Crop yield in lb./acre	Loss per acre in Shs. dusted v. control, based on end of year price of Sh. 1/- per kilo of nuts
Nil (Control)	—	80.4	40.0	113.7	—
5% DDT 14 (Shs. 173/60)		5.3	45.3	192.5	138/58
0.5% gamma BHC. ... 14 (Shs. 92/40)		9.0	37.3	194.3	56/58

*Based on damage scored, clean=0, light=1, moderate=2, heavy=3.

The increase in yield due to the use of insecticide was in no case economic. As this was the first year of bearing only relatively small yields could be expected. One effect, difficult to measure, is that which the insects have on the growth of the tree, the main leader shoot being suppressed and subsequent growth, if any, taking place as a witches-broom type of growth from axillary buds. In the experiment with the Portuguese East Africa variety of cashew practically all the buds in the undusted areas were prevented from developing, the trees losing one year's growth all round. Work on the control of the pests is being continued.

Cashew kernel spotting, caused by a sucking bug which is also able to inoculate the seed with the fungus *Nematospora coryli*, was more prevalent than in previous years. Of 446 nuts examined from a parcel from the Mtwara/Newala areas of the Southern Province 30 per cent showed spotting; the previous highest percentage was 13 per cent. The average of counts on 4,987 nuts collected from a number of localities in 1953 was slightly under 5 per cent. Owing to other commitments it has not been possible to carry out any work on this problem this year.

Maize and Sorghum.—Detailed field work in Western Province on the biology of the Noctuid borer, *Busseola fusca* Fuller, has been carried out as a basis for the control of the insect. The adults, which appear shortly after the onset of the rains in December, begin egg-laying on the plants when they are about two weeks old, the egg-laying period being approximately three weeks. Control of the 1st generation larvæ has been achieved by the application of 2.5 per cent DDT

dust into the funnels of the plants at the rate of 5 lb. per acre per application. The results of treatments carried out at Mwanhala experiment station are given in Table III.

TABLE III
THE EFFECT OF DUSTING WITH 2.5% DDT DUST IN CONTROLLING *BUSSEOLA FUSCA* F. IN MAIZE

DDT days after germination	Total plant hills per treatment	Percentage damaged plant hills 47 days after germination	Yield of naked maize per treatment in kilos
a. 29... ..	1,924	5.7	152.6
b. 22 and 29... ..	1,962	14.5	167.4
c. 22 and 32... ..	1,923	2.9	144.8
d. 22, 29 and 36	1,911	1.7	187.8
e. Control untreated	1,951	31.3	164.6

Differences not significant. All treatments better than control, $P=0.01$. Differences not significant.

The absence of significant yield differences was undoubtedly due to the low incidence of infestation over the area: the larval population at its peak, forty-six days after germination, was approximately 3,600 per acre only.

Trials on maize on twenty African shambas in the Nzega District in which 2.5 per cent DDT dust was applied to one half of each plot three times at weekly intervals beginning twenty-one days after germination gave results on four plots only. Maize in fourteen of the twenty plots was so badly affected by a combination of poor soil conditions and a drought in February that they were abandoned. Two plots were harvested by the owners without reference to the Agricultural Department. The detailed results from the four surviving plots are given in Table IV. It is probable that the use of chemical control against *Busseola* in maize would be worthwhile in the case of the better farmers in the Western Province and considerable propaganda has been put out by this office with the assistance of the Provincial Agricultural Officer. Selected farmers and schools are now co-operating in large-scale trials. In many other cases it is clear that the basic level of cultivation is so poor that no amount of chemical treatment will affect the yield. Any progress on pest control in these cases will be dependent on improved general agricultural education.

TABLE IV
THE EFFECT OF DUSTING WITH 2.5% DDT DUST AGAINST *BUSSEOLA* ON MAIZE IN AFRICAN PLOTS, NZEGA, WESTERN PROVINCE, 1954/55

Plot Number	Total number of plants at harvest		Total weight of naked maize in Kilos		Areas of sub-plots Square yards	Anticipated profit per acre after adjustment of yields to basis of equal plant numbers in treated and control plots
	Control	Treated	Control	Treated		
						Shs. *
1	464	536	4.5	7.5	180	16/30
2	448	531	3.5	16.0	180	70/95
3	478	394	15.5	28.0	164	62/20
4	309	474	11.5	20.5	200	5/90

*Based on selling price to producer of 27 cents per kilo of naked maize.

Control of *Busseola* in the long-term Wiru sorghums of Western Province has not been seriously attempted; their long growing period makes them vulnerable to the attacks of the 2nd and 3rd generations of the insect and their height precludes any simple measure of control suited to the peasant farmer.

In the Mbeya District considerable assistance was given by the Field Officer in trials against *Busseola* on maize in African shambas. Each plot was divided into a treated and an untreated half, the areas of which varied from $\frac{1}{4}$ acre to $1\frac{1}{2}$ acres. 2.5 per cent DDT in diatomite dust was applied four times at weekly intervals beginning as nearly as possible eighteen days after germination of the maize. Results from thirteen plots are shown in Table V; the calculated average increase in naked maize yield; dusted V. control, was 822.4 ± 403.2 lbs. per acre.

TABLE V

THE EFFECT OF DUSTING WITH 2.5% DDT AGAINST *BUSSEOLA* ON MAIZE IN AFRICAN PLOTS, MBEYA, 1954/55

Plot Number	Total Plant Hills in sample	% hills damaged 70-75 days after emergence of maize		Naked cob yield in lb. per 100 plant hills		Increase in yields in lb.
		Treated	Control	Treated	Control	
1	1,100	17.6	20.8	32	20	12
2	1,025	1.8	53.3	52	24	28
3	1,375	1.2	18.5	38	30	8
4	1,500	0.3	13.8	28	20	8
5	1,000 Treated 1,050 Control	3.3	45.5	85	18	67
6	950	7.3	39.2	66	22	44
7	670	11.6	33.2	76	32	44
8	1,122	6.0	45.4	59	26	33
9	615	5.2	19.2	76	32	44
10	360	2.2	16.9	44	38	6
11	594	1.7	8.2	28	28	0
12	760	1.4	17.4	56	38	18
13	N.R.	—	—	42	29	13
Means		4.96	27.61	50.30	27.46	22.84

Differences between means significant
P = 0.05

22.65 ± 5.61

22.84 ± 11.16

A 250-acre block of Enyanza sorghum at Kingolwira, near Morogoro, was heavily attacked in the milk-stage by *Heliothis armigera* Hbn in May. At the time of inspection upwards of six 4th or 5th stage larvæ could be readily observed on practically every head of sorghum. Aerial spraying with $\frac{1}{2}$ lb. of actual DDT per acre effected a very good control, the overall cost working out at Shs. 23/- per acre.

Underground pit storage of high moisture content maize.—Trials on two 120-ton parcels of high moisture content Uganda maize in experimental pits at Moshi and Morogoro were brought to a close owing to the deterioration taking place in the maize. Changes which occurred in both cases were loss of palatability, loss of viability and darkening of the grains. With the Moshi parcel, which was the wetter of the two and ranged from 13.5 per cent to 20 per cent moisture content with an average of 16.9 per cent, the storage period was 144 days; the maize at Morogoro with an average moisture content of 14.8 per cent kept for 374 days. Both parcels required conditioning and admixture with a more palatable grain before they could be offered to the public. Whilst it is clear that the long-term underground storage of high moisture content maize is not a practicable

proposition it is of interest that the maize on removal was in generally better condition than had it been stored for the same lengths of time in a bag stack in a godown.

Kapok.—Damage by the stem-girdling Lamiid beetle, *Tragiscoschema nigroscripta*, Fairm, on a large estate at Kisaki in the Eastern Province has once more been very heavy. According to figures received from the owner the yield of lint kapok from one plantation of 850 acres has fallen from 75 tons in 1953 to 45 tons in 1954 and to 10 tons in 1955, mainly as a result of damage by the insect. Whilst large year to year variations in yield are characteristic of kapok there can be little doubt that the insect is responsible for a considerable loss and that much detailed work on its biology, status and possible means of control is required. Periodic sampling in the field so far supports the results obtained from laboratory breeding last year that only one generation is produced per year, with a prolonged period of larval development. Laboratory tests of a number of insecticide emulsions by Mr. P. T. Walker, Colonial Insecticide Research Unit, Arusha, have confirmed the writer's finding last year that the most effective of the more common insecticides is gammexane.

Coconuts.—Two aerial applications of a 10 per cent DDT emulsion at a dosage of $\frac{1}{2}$ lb. of active ingredient per acre were made on an estate on Mafia island in October against the sucking bug *Pseudotheraptus wayi*. Insufficient control of the pest was obtained and further trials with different concentrations, dosages and swathe-widths have been arranged in conjunction with the Colonial Insecticides Research Unit for January/February, 1956. This work is complementary to that being carried out on the same pest in Zanzibar by Dr. F. L. Vanderplank who is also giving technical advice on the Tanganyika trials.

MISCELLANEOUS RECORDS

<i>Anidiomytilus albus</i> Ckll. ...	...	Cassava ...	...	Mbeya, Nzega, Singida.
<i>Diparopsis castanea</i> Hmps. ...	...	Cotton ...	...	Tunduru.
<i>Empoasca</i> sp. ...	...	Cotton ...	...	Eastern Province.
<i>Empoasca</i> sp. ...	...	Cotton ...	...	Pare District.
<i>Dicasticus geminatus</i> Kolbe. ...	...	Eucalyptus and Camphor ...	...	Bunduki, Morogoro.
<i>Gonocephalum simplex</i> F. ...	...	Young Wattle ...	...	Njombe.
<i>Athalia</i> sp. ...	...	Vegetables ...	...	Morogoro.
<i>Faureia milanjica</i> Karsch ...	...	Maize ...	...	Kibonde.
<i>Marasmia trapezalis</i> Gn. ...	...	<i>Panicum maximum</i> ...	...	
		<i>Panicum trichlorodactum</i> ...	...	
<i>Marasmia trapezalis</i> Gn. ...	...	Young Maize ...	...	
<i>Leptoglossus membraneus</i> F. ...	...	Oranges ...	...	Chole Island.
<i>Plusia orichalcea</i> F. ...	...	Flax ...	...	Njombe.
<i>Inesida leprosa</i> F. ...	...	Mulberry ...	...	Morogoro.

PUBLICATIONS

The Cotton Red Bollworm Problem in Southern Tanganyika. Swaine, G., Evans, A. C., and Ward, J. B., *East African Agricultural Journal* XX No. 3183.

A paper on Trials on the Underground Storage of High Moisture Content Maize in Tanganyika has been submitted for publication.

ACKNOWLEDGMENTS

Thanks are again due to the Director and Staff of the Commonwealth Institute of Entomology. I would also like to thank Departmental officers in the Western, Southern Highlands and Eastern Provinces who have either taken records or assisted in other ways in the experimental work.

G. SWAINE,
Entomologist

ANNUAL REPORT OF THE ENTOMOLOGIST, LYAMUNGU, MOSHI FOR THE YEAR, 1955

INTRODUCTION

The year as a whole has been a favourable one for insects, particularly during the early part of the main growing season when cutworms, armyworms and other caterpillars, together with beetles and their larvæ and other pests, destroyed large acreages of young maize and beans. Luckily the weather was suitable for replanting maize although beans in most cases were not replaced. Many of the beans that did survive the original set-back later suffered from a peculiar condition referred to as "oily-pod".

Once again the coffee-borer received a great deal of attention. A method of controlling the insect has been proven both experimentally and in general practice by several farmers, and work on this insect is drawing to a close.

COFFEE

White Coffee-borer (*Anthores leuconotus*).—This work, begun in 1954 largely with Coffee Board funds, has continued satisfactorily and according to plan.

Plots were laid out on fourteen estates scattered over the Moshi and Arusha Districts in one 150-acre statistical trial. In addition subsidiary experiments and observation plots were placed on seven other estates and nine African small-holdings. On some farms the infestation was low, but nevertheless enough data has been collected to show that a $\frac{1}{2}$ per cent dieldrin emulsion, applied twice yearly to the lower 18 inches of the main stems, and at the rate of up to 18 gallons of the insecticide per 540 trees (one acre of $9' \times 9'$ planting) per application, gave a very satisfactory control. Some larvæ can usually be found above the treated band, but these are few and can readily be dealt with manually. Dieldrin at $\frac{1}{2}$ per cent concentration was as effective as dieldrin at $\frac{3}{4}$ per cent, 1 per cent and $1\frac{1}{2}$ per cent concentrations, and it may well be that the most economic concentration has not yet been found. The cost of insecticide and methylene blue, which serves as a marker, is in the region of Shs. 60/- per acre per year.

A suitable method of controlling borer for the peasant farmer at a much lower cost was also devised. A band of $\frac{1}{2}$ per cent dieldrin emulsion (with Methylene blue) applied with a brush on the main stem extending from 3 inches below soil level to 6 inches above soil level gave excellent control of the borer in the root system where most of the damage occurs. The borer living above the band can readily be removed manually before any real damage is caused to the tree. Two applications per year are necessary and costs of the insecticide per year is in the region of Shs. 15/- per 600 trees, more or less depending on the methods of buying and distributing the chemicals.

Dieldrin lacquer was also applied to plots within the main experiment and observation plots. Its true value cannot be estimated until late 1956.

The bionomics of the pest have been studied throughout the year. Altogether over 2,600 trees have been uprooted from representative estates and from these 3,300 insects have been dissected out and their head measurements taken.

A survey of the incidence of the pest on Kilimanjaro was made involving the examination *in situ* of over 10,000 trees. It was found that the borer had advanced considerably up the mountain in many places since 1950 when the last survey was made.

A study of the distribution of borer in the tree confirmed that approximately 80 per cent of all borer attack the lower 18 inches of the tree in old infested coffee. In newly infested coffee however it is apparent that a higher percentage attacks the lower part of the trees, but this has not been proven as, naturally enough, no planter is willing to sacrifice mildly damaged trees. Experience has shown many times that it is useless to make a survey of this sort unless trees can actually be uprooted and cut up.

A brief study of wild host trees shows that there are still many wild hosts which harbour a considerable population of borer. It would appear to be quite impossible to eliminate these trees as they are exceedingly numerous especially in the bush and forest near rivers. The hosts are quick to regenerate and able to survive herbicide treatment. Elimination of borer is therefore clearly out of the question and it will be necessary, once borer has been controlled in coffee, to organize local borer campaigns from time to time unless control measures are employed annually as routine.

Stem and root temperatures of coffee have now been taken for over one year and it remains to study the data. It is hoped in time to correlate the length of life-cycles with the tree temperatures.

Data in hand was reviewed in August and September and a pamphlet entitled "The White Coffee Borer—How to Fight It" was published in English and Swahili early in October. Nine thousand copies were distributed and an exhibition of borer control was staged at the Moshi Agricultural Show. As a result it is estimated that over half of the estate coffee in the borer zone has been treated to date. A few Africans have treated their coffee, but the majority are awaiting action through the Co-operatives which so far has not been forthcoming in the main African growing areas.

Full details of the work will be published elsewhere.

Stephanoderes.—A poor start was made in experiments on *Stephanoderes* control at Bukoba. Indications are that endrin applied at the rate of $\frac{1}{2}$ gm. of actual material per tree does effect some control.

Leaf-miner.—Work on the chemical control of leaf-miner has been discontinued because of the pressure of other work and because this problem is due to be studied in Kenya. A pest assessment trial has been planned and will be planted on the Coffee Research Station in 1956.

MAIZE

Widespread outbreaks of *Phytometra orichalcea*, *Laphygma exigua*, *Prodenia litura* and *Marasmia trapexalis* caused extensive damage in the early part of the year when the rains stopped soon after germination, thus retarding normal plant growth. Some farmers successfully sprayed smaller plants with DDT but in many cases fields had to be replanted.

Heliothis armigera, the American Bollworm, was found breeding up in maize cobs, but the damage caused was negligible compared with previous outbreaks.

BEANS

Most beans grown in peasant holdings suffered severely from the bean-fly (*Agromyza phaseoli*), and Galerucid beetle (*Ootheca mutabilis*). Bean-fly could also be found over most of the seed-bean growing areas, but the infestation appeared to be a comparatively late one and the plants formed adventitious roots where conditions were favourable and cropped fairly well.

The bean-fly was heavily parasitized by *Opius* sp. (*Opiinae*, *Braconid*).

Exploratory experiments on bean-fly control are in hand. It is known however that one application of DDT, and aldrin as a seed-dressing at 0.4 lb. of aldrin per 100 lb. seed, is quite ineffective.

American Boll-worm, which bred up successfully in maize, laid large numbers of eggs in many bean fields. Aircraft stood by to spray, but very few fields needed treatment. The reason for the failure of the eggs to hatch was investigated and it was found that almost all the eggs were parasitized by a minute Chalcid. The few caterpillars which survived were considerably reduced in number by other natural factors.

On the few farms which were sprayed it was found that $\frac{1}{2}$ lb. DDT gave an excellent kill of 1st instar larvæ, but where all instars were present 1 lb. DDT was necessary to effect a control.

Towards the end of the bean season, when no trouble is expected from pests and diseases, large acreages of hitherto apparently healthy beans showed severe die-back, puffy and oily-pods. A team, comprising a pathologist, physiologist and entomologist, concluded that it might be caused by virus, possibly insect transmitted. As a result all insects found on beans which could be suspected of carrying a virus have been collected for identification. That the condition is serious is indicated by the experience of one farmer who, having had an excellent stand of beans before the disease occurred, took half the expected crop from the fields, half of which was rejected in the sorting sheds.

SEED DRESSINGS

Soil pests caused extensive damage to seed and young plants in areas of irregular rainfall. Two observation plots, each well over 50 acres, were replanted with seed treated with aldrin.

Cutworm (Euxoa segetum).—A spectacular kill of this pest was obtained in maize and bean fields with seed treated with 1 lb. of aldrin 40 per cent WP per 100 lb. seed, and planted in the top inch of soil by a mechanical planter. Within a day or two of planting cutworms came to the surface and died whereas in an adjacent field in which the seed was not dressed cutworm continued to destroy young seedlings. A further experiment revealed that if seed was planted deeper in the soil few cutworms were affected.

Chafer (Gen and sp. not known) Rutelinae.—In one field where maize seed was treated primarily against cutworm large numbers of chafer-grubs, far more than were thought to be present, came to the surface and died.

Other insects which were killed as a result of the seed-dressing include *Gonocephalum simplex*, *Zophosis* sp. and several beetles of little importance.

No control of cutworm and chafer was obtained by using BHC baits either scattered on the land or drilled in with the seed.

In wheat seed dressing with aldrin appeared to give an excellent control of *Cydnius* sp. in one small plot.

SUGAR

An experiment laid out in 1954 by A. J. Jones, designed to compare aldrin and BHC in controlling *Cochliotis melolonthoides*, the sugar-cane white grub, was evaluated during the year with the cutting of the cane crop. The insecticides were applied in the planting furrows as a band treatment.

Results are as follows:—

Treatment		Population of Chafers per acre	Tons of Cane per acre
BHC	2.6% dust at 1 cwt./acre ...	23,000 ...	45.4
Aldrin	2½% " " 1 " ...	6,000 ...	49.5
Aldrin	2½% " " ½ " ...	7,000 ...	51.9
Aldrin	2½% " " ¼ " ...	17,000 ...	45.2
Nil—Control		54,000 ...	36.4

At the 5 per cent level all treatments significantly reduced the population of chafer grubs, and aldrin dust at 1 cwt. and ½ cwt./acre were better than BHC dust at 1 cwt./acre and aldrin at ¼ cwt./acre.

At the 1 per cent level of significance all treatments except BHC were better than control. Aldrin at 1 cwt. and ½ cwt./acre was better than BHC and aldrin at 1 cwt./acre was nearly significantly better than aldrin at ¼ cwt. of dust/acre.

While the yields followed roughly the chafer population trends there were no significant differences.

The experiment will continue for a further two years or more.

SISAL

A leaf-spot of sisal has caused concern to a number of estates near Korogwe. A close study of the spots by the Sisal Research Station staff has indicated strongly that an insect is responsible for the damage. The condition is serious to the estates involved and entomological observations are being undertaken. It would appear that, if an insect is responsible, the populations are likely to be very low and so far only one insect which could cause the damage has been noted, but this has also been observed where leaf spots do not occur.

ACKNOWLEDGMENTS

I am particularly indebted to Mr. R. O. Bowley, seconded from Messrs. Plant Protection Ltd. to the Coffee Board, who has carried out the bulk of the field work on coffee borer; and to the African staff of this laboratory who have given us every support in a particularly arduous year.

I am also grateful for the co-operation of the representatives of the three major insecticide distributors, Messrs. Pest Control Limited, Plant Protection Limited and Shell Chemicals Limited.

The Colonial Insecticide Research Unit, Arusha, and the Commonwealth Institute of Entomology have continued to give every assistance.

The help of Mr. J. I. Thomson of the Department has been most invaluable in planning experiments and statistical analysis.

R. G. TAPLEY,
Entomologist

ANNUAL REPORT OF THE PLANT PATHOLOGIST, LYAMUNGU, FOR THE YEAR, 1955

STAFF

Dr. G. B. Wallace retired and Mrs. M. M. Wallace resigned at the same time in March. Mr. N. B. Joy visited the laboratory from time to time during the period March to July to attend to urgent matters. Dr. E. A. Riley was transferred from Northern Rhodesia and assumed duty at Lyamungu on the 21st July. Mr. Basil A. Kalisti and Mr. Marko Kristonsia, African Laboratory Assistants, were on duty throughout the year. Dr. E. A. Riley proceeded on vacation leave in November. The year has, therefore, been a very interrupted one from the point of view of staff.

TOURING

A meeting of the Specialist Committee on Agricultural Botany was attended at Kawanda, Uganda, over the period 5th to 6th October.

PUBLICATIONS

"Bark Diseases of Coffee"—G. B. Wallace and M. M. Wallace in the *East African Agricultural Journal*, Vol. XXI, No. 1, July, 1955. "Sudden Death Disease of Cashew Trees in Tanganyika—A preliminary Note"—G. B. Wallace and M. M. Wallace in the *East African Agricultural Journal*, Vol. XXI, No. 1, July, 1955.

LABORATORY AND ADVISORY WORK

One hundred and six specimens were received for examination during the year. The following new records were noted:—

- Cashew: *Valsa eugeniae* Nutman and Roberts.
- Potato: Leaf Drop Streak (Potato Virus Y).
- Tobacco: Ring Spot (undetermined virus).

NOTES ON CROP DISEASES

Banana.—Panama disease continues to occur sporadically in the Kilimanjaro area and one outbreak was recorded from the Arusha District. Destruction of infected bananas has been continued by the Agricultural Officer, Moshi.

Beans.—A disease known as "oily pod" to growers first made its appearance in the Arusha District in 1954. A preliminary examination was made by Dr. Wallace. In the 1955 season, the disease was found to be more widespread and a survey was made to determine the cause of the trouble. The survey was carried out by the writer, the Entomologist, Lyamungu, and the Plant Physiologist, Mlingano. Investigations suggested strongly that the disease was of virus origin. It was agreed that the Plant Pathologist, Arusha, would undertake investigations to determine the nature of the disease but these have now had to be discontinued owing to lack of greenhouse facilities.

Symptoms found in association with the "oily-pod" conditions are as follows: On mature beans, an "oily" feel to the pod and rather darker colour than normal. Beans within may or may not be arrested in their development. On breaking open the pods, a fusty smell is often evident. Symptoms on younger plants

include interveinal chlorosis of the leaves, tips die-back of the branches, a "puffy" feel to the pods as if these are filled with air. Symptoms have been found to be extremely variable. Subsequent search has shown the disease to be present over a wide area of Tanganyika and the writer has seen it also in Uganda.

Cashew.—The fungus *Valsa eugeniae* found in association with the cashew disease in the Lindi area is that which is associated with Sudden Death in cloves. The significance of this discovery is described in a note in the *East African Agricultural Journal* for July, 1955.

Sugar-cane.—A "drying-up" of the pith was found in some of the Co 421 cane at Arusha Chini. The ratoon cane in question had been held over for twenty-three months before cutting instead of the usual eighteen months. It is considered that this may have been the cause of the trouble. However, as a precautionary measure it was recommended that no cane should be taken from the particular field for propagation elsewhere.

Tobacco.—A form of tobacco ring-spot was seen in native tobacco at Lyamungu. The disease was not found to be severe or causing any apparent damage. The precise ring-spot virus responsible has not been determined.

Tomato.—Grey Leaf spot (*Stemphylium solani*) continues to cause damage in the Muheza District. "Zineb" preparations are being tried to control the disease.

Miscellaneous.—Cultures of legume inoculant continued to be supplied on request.

No information is available on the crop disease situation in the various provinces of the Territory.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to the Director of the Commonwealth Mycological Institute and to Dr. W. L. Gordon of Winnipeg, Canada, for identification of cultures.

E. A. RILEY,
Plant Pathologist

ANNUAL REPORT OF THE PLANT PATHOLOGIST, ARUSHA, FOR THE YEAR 1955

STAFF

The Plant Pathologist, Arusha, was on duty throughout the year, except for the latter half of May, following an accident which also reduced his activities to a large extent from June to August.

TOURING

The Plant Pathologist paid many visits to the Plant Pathologist Laboratory, Lyamungu. The Essimigor area was toured in connection with the dwarf bean survey. A meeting of the Tanganyika Seeds Board was attended by invitation in February.

DWARF BEANS

Disease Survey.—Only the Essimigor area was surveyed. Very little disease was seen at the time, probably because all the land was new or fairly new to cultivation, and because of the prevailing dry weather.

It was noticed that nodulation of bean roots was nowhere extensive and in many instances virtually absent. Although fair yields seem to be obtained in some cases under these conditions, more attention should be given to the inoculation of legume seed planted in areas new to cultivation. In the few plants examined in fields near Arusha nodulation seemed to be satisfactory. Preliminary investigations into the whole problem of legume nodulation in the Arusha area were started this year.

"Oily Pod".—In the latter part of the growing season a survey of dwarf beans was made by other members of the Agricultural Department, and they reported the widespread occurrence of a condition which was termed "oily pod". This laboratory has taken over some investigations of this condition, but it is still not known whether it is a parasitic disease. Grafting has been unsuccessful, and inoculation and injection experiments have so far proved negative. The Plant Pathologist, Lyamungu, and the Entomologist, Lyamungu are carrying out further investigations.

Hard Seed.—The problem of hard seeds in dwarf beans has come into prominence this year, especially in haricots destined for the canning trade. The unusually dry conditions appear to have aggravated this problem, which seems to be largely dependent on atmospheric humidity. A number of samples of seed from this year's crop, both of the haricot type and of the Dutch Princess type, were collected and tested for their hard seed content. The percentage of hard seeds after immersion in tap water for any specified time was determined by counting the seed that had not imbibed water, and adding to that number half of the seed that were only partially hydrated. The samples were tested almost immediately on receipt, and so the storage conditions (atmospheric humidity) prior to testing for each of the samples was almost certainly different. Below are given the highest and lowest percentages of hard seeds found in the samples after twenty-four hours in tap water at room temperature (about 70°F):—

Type of seed						Percentage Hard Seed	
						Highest	Lowest
Haricot	...	...	...	...	...	38 per cent	2 per cent
Dutch Princess	...	...	...	...	...	84 "	16 "

After being tested the samples were left in open conditions in the laboratory. Subsequently there followed a rainy period of higher relative humidity. These conditions resulted in a change in the hard seed content of the samples, e.g. as shown below:—

Sample No.						Percentage Hard Seed (24-hour immersion period)	
						Before Rain	After Rain
1 } Haricot	...	...	...	...	...	38 per cent	1 per cent
2 }						38 "	Nil
3 } Dutch Princess Type	...	...	...	...	...	79 per cent	38 per cent
4 }						84 "	15 "

The type of hardness known as sclerema ("Sclerema and Hardshell, Two Types of Hardness of the Bean" by Gloyer, W. O. *Proc. Assoc. Official Seed Analysis* 13,60 (1921)) has not so far been encountered in Tanganyika seed, and all hardness has been eliminated by scarification or hot water treatment (immersion in boiling water for one minute).

Halo Blight.—An attempt was made to determine the time taken for the symptoms of halo blight to appear in plants grown from infected seed. Unfortunately no symptoms appeared throughout the growth of the plants. As the seed used was taken from a crop heavily infected with halo blight, it appears as if the causal organism is not necessarily seed borne to a large extent under all conditions.

Seed Defects.—Figures for the yield of seed were collected for dwarf bean crops selected at random in the Arusha, Monduli and Oldeani areas. For the 1954 crop the average yield was 4.1 bags per acre. From figures supplied it was found that from 4,500 bags, 27.2 per cent were rejected; of these 9.5 per cent were machine rejects and 17.7 per cent were hand rejects. Although there may be slight differences in the criteria used for rejection by machine and hand sorting, this does show that nearly two-thirds of the rejects were of good-sized seed.

Samples from many of these crops were collected for examination. The types of defects encountered were cracked skins, moisture wrinkling, burst skins, insect damage (wrinkling due to puncturing of the skin by *Hemiptera*, and damage by boll-worm, weevil and bruchid beetles), yeast spot and blisters (caused by *Nematospora coryli*, transmitted by insects), and shrivelling and/or discoloration (causes mainly undetermined, probably various). Of the rejects as a whole, cracked skins, moisture wrinkling and shrivelling discoloration were the most common. Burst skins were relatively uncommon, the variety Prince suffering most; however, in one crop this defect comprised 50 per cent of the rejects and caused a loss of 10.7 per cent of the total crop. Burst skins were also found in five other varieties. Insect damage was also relatively uncommon, but it is known that this can be much more severe in some years. Damage due to *Nematospora coryli* was only found in a few samples, and in these it comprised a fairly high proportion of the rejects.

The last three defects mentioned are either outside the growers' control or vary according to the year and to the efficacy of insecticidal control. Shrivelling/discoloration (mostly found in the machine rejects, of which they constituted the majority) are largely outside the growers control at the moment. However, cracked skins and moisture wrinkling are within the growers control, and in fact

together usually constituted the majority of the hand rejects. This confirms previous experience. Each often accounted for up to 50 per cent of the hand rejects, and for up to 10 per cent of the total crop. In one instance, cracked skins caused the loss of 30 per cent of the crop. Proper attention to harvesting, threshing and storage should reduce considerably the losses due to these two defects.

GERMINATION TESTING

Routine testing was continued, and seventy-six samples were tested for growers as compared with thirty-six in 1954. This is a very small number for the territory as a whole. A wider variety of seeds were tested than last year, and different methods of testing were tried to compare results.

Studies were continued to find the effects of certain seed defects of germination. The seeds used were of Masterpiece variety and were germinated in sterilized sand. The defects tested were cracked skins, burst skins, wrinkling due to insect attack and spotting and blistering due to *Nematospora coryli*. The results were as follows:—

Seed type				Germination Capacity (Average for a number of tests)	
Normal	...	...	...	...	84 per cent
Cracked skins	...	...	...	...	26 " "
Burst skins	...	...	...	...	73 " "
Insect wrinkles...	...	...	...	...	84 " "
<i>N. coryli</i>	...	...	...	...	83 " "

The results from cracked skins confirm those from 1954. The results obtained with wrinkling and *N. coryli* varied, and the average given above is very different from the results obtained in 1954, when the germination capacity was found to be much lower. It appears as if the germination capacity varies according to the severity of the attack, although the severity is not obvious from external appearance.

MAIZE

The occurrence of pink ear rot was reported as being the worst for a number of years. The worst areas were Olmotonyi and Usa River, near Arusha. It appears as though the causal organism can be carried long distances, by wind, and sanitary measures of control must be practised consistently over whole areas to be effective. The control of this disease complex may only be finally achieved through plant breeding.

Attempts with various fungicides to increase the germination capacity of maize seed infected with *Gibberella* spp. proved negative. The conditions of growth were warm and fairly dry.

As in 1953 there was widespread occurrence of head smut in African areas. An attempt should be made to introduce fungicidal seed dressing to African growers.

WHEAT

Stem rust (*Puccinia graminis*) was severe in all the main wheat growing areas this year. It is intended to experiment with the new systemic fungicide, Acti-dione, in an attempt to control this disease.

WEEDICIDES

An experiment was conducted to determine the type of damage done to various crop plants by the application of a selective weedicide. During the past year there had been a number of instances of drift causing damage to neighbouring

fields. This experiment was conducted so that a knowledge of the symptoms to expect would be known beforehand. It confirmed that the previous diagnoses given to farmers had been correct.

The weedicide used was Agroxone 4, and the crop plants tested were dwarf beans, peas, maize, potatoes, tomatoes, papaw and coffee. Except for coffee the concentrations of weedicide used were 1 lb., $\frac{1}{2}$ lb., $\frac{1}{4}$ lb. and $\frac{1}{8}$ lb. of MCPA active acid equivalent per acre; 2 lb. per acre was used on coffee. The concentrations used were high so as to produce well developed symptoms. At the time of application the beans, peas, potatoes, tomatoes and maize were well grown and in the pre-flowering stage (six weeks old); both mature and young coffee plants were sprayed, and the papaw was about one foot high.

It cannot be definitely said that any of the test plants were killed by the weedicide application; in fact, the papaw and tomato plants did die eventually, but these contracted disease during the experiment, and it is possible that their death was due to a combination of disease and weedicide. As expected the higher the concentration the more developed were the symptoms, but there was only a difference of degree, not of kind. Also, higher concentrations did not result in the symptoms appearing any earlier.

Symptoms started to appear three days after weedicide application in beans, tomatoes and papaw, after seven days in maize and coffee and after twelve to fourteen days in potatoes and peas. This time lag corresponded roughly to the different susceptibilities of the respective plants. Peas were definitely the least affected, and on visual appearance beans the most affected; however, an exact comparison of susceptibilities was not possible owing to the differing ages of some of the plants, and also due to the fact that visual effects may not be a true reflection of the real damage, i.e. drop in yield (yields were not recorded). A brief description of the symptoms obtained follows:—

Dwarf Beans.—The immediate effect *en masse* is a blight and wilt. The young leaves are most affected, and the leaves go thin and papery, gradually turning brown completely or in irregular patches; often the veins and surrounding tissue remain green, especially towards the base. Less affected leaves show a curling inwards. The leaves of later new growth show a distal chlorosis, especially along the edges, and sometimes a necrosis develops. Intervinal puckering and a cupping effect are common, and there may be a General twisting of the leaflet. The stems show minor curling and twisting, and a later fluting and thickening, with the bundles showing markedly. Pulvini swell and the leaflets fall off at this point; nodes are often much enlarged.

Tomatoes.—The stems show a curling and twisting, and may fall right over. A discoloration appears around the edges of the leaves, which roll in slightly.

Papaw.—There is a general curling and twisting of the leaves, stems (which may fall over) and petioles.

Maize.—The nodes are affected mainly, causing the plants to fall over and then gradually right themselves; the nodes swell and put out protuberances (from the root initials).

Coffee.—Necrotic spots (which may fall out) appear on the leaves. There is some distortion of the young leaves, and the berries darken.

Potatoes.—The effect only showed in new growth developed since the time of application. The general effect is a spindly appearance; the whole leaflet becomes puckered and distorted, with the veins tending to remain parallel to the midrib. Later new growth is again normal.

ROUTINE ADVISORY WORK

This was continued throughout the year, mainly in the Arusha area. *Perenospora viciae* (Berk.) Casp. found on peas, and cucumber mosaic virus in cucumber are recorded for the first time from Tanganyika.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to the Officer in Charge of the Colonial Insecticide Research Unit, Arusha, for the provision of laboratory accommodation, to the Director and staff of the Commonwealth Mycological Institute, Kew, for the identification of specimens and to Messrs. Sheriff Dewji & Sons, Arusha, for their every assistance in connection with bean seed work.

N. B. Joy,
Plant Pathologist

ANNUAL REPORT OF THE BOTANIST, UKIRIGURU, 1954-55 SEASON

STAFF

H. Doggett, Botanist, returned from leave in January and took over the work again from B. G. Houston, Botanist, on 17th January. Houston transferred to Ilonga on 27th January. A. K. Auckland, Botanist, arrived on first appointment on 16th September, 1955.

GENERAL

Considerable difficulty was experienced in establishing sorghum, owing to poor distribution of rainfall in October to December, 1954. Rainfall figures for these months are given below:—

Rainfall 1954						
October	25th	...	...	...	...	0.20 inches
	26th	...	...	...	...	0.07 "
	30th	...	...	...	...	0.21 "
November	4th	...	...	...	...	0.85 "
	10th	...	...	...	...	0.12 "
	26th	...	...	...	...	0.07 "
	30th	...	...	...	...	0.30 "
December	2nd	...	...	...	...	0.25 "
	3rd	...	...	...	...	0.37 "
	6th	...	...	...	...	0.60 "
	7th	...	...	...	...	0.45 "
	15th	...	...	...	...	0.12 "
	28th	...	...	...	...	0.45 "

A later planting in February, remote from the earlier planted sorghums, proved very successful.

The season was a bad one for Striga, the number of plants appearing above ground being greatly in excess of the usual number. Abundant Striga was also reported from many other parts of the province. Stalk borer attack appeared to be heavy in some places, but there was a suggestion that the damage seemed to be more severe where Striga was most evident. It is probable that a plant already weakened by Striga is less able to recover from borer damage than a healthy plant, and this observation is to be followed up.

Neither Central Shoot Fly nor birds gave much trouble this season.

A—SORGHUM BREEDING

(1) *Early maturing grain-weevil resistant varieties.*

(a) *B.C. 27 × Wiru crosses.*—The object of these crosses is to transfer the palatable, weevil-resistant grain from the late maturing Wiru variety to the early maturing, soft grained B.C. 27 parent.

The most promising line from the B.C. 27 × Wiru first cross, SUK. 1, was grown on a fair scale at Ukiriguru, and Lubaga. The rainfall distribution was such that the yields of early planted SUK.1 were poor, being 400 lb. per acre on 30 acres at Ukiriguru, and 350 lb. per acre on 85 acres at Lubaga. Trial plots at Dodoma and Musoma reported yields of 1,600 lb. per acre and 800 lb. per acre respectively, and yields of 1,680 and 1,750 lb. per acre were obtained on two Ilonga trials.

The S.U.K. 1 showed up very well in storage tests, with a weevil resistance equal to that of Wiru, and untreated bagged grain showed no sign of weevil damage in store either at Ukiriguru or Lubaga six months after harvest.

Comments on the grain have been most favourable, but the head is rather small, and the yield is below the standard required, although this year's yields are only about half those to be expected in a less difficult season.

B.C. 27(2) × Wiru, first backcross.—Two very promising lines were developed to the bulking stage this season, 42B and 36D. Both have much larger heads than S.U.K. 1. 42B looks somewhat less vigorous than 36D, but has a grain as good as that of Wiru. 36D is the better plant, but the weevil resistance of the grain is intermediate between that of Wiru and B.C. 27, as shown by storage tests. Both mature within four months of planting, and are rather taller than the S.U.K. 1. Bults are being grown for observation in the 1955-56 season, and they will go into the district plot trials.

B.C. 27(3) × Wiru, second backcross.—Progenies from this cross have been disappointing, very few wholly corneous grains appearing, and it is likely that this cross will not be pursued further.

Five hundred and seventy-five progeny rows from the above crosses were grown.

(b) *Other crosses.*—Efforts have been concentrated on the B.C. 27 × Wiru cross and backcross, to obtain an early maturing sorghum with a good grain as quickly as possible, but from a long-term view a broader genetic basis is required. To this end, three early maturing parents, B.C. 27, Dobbs, and Oklahoma 44/14, together with six late maturing parents, Wiru, Msumbiji, Belko (from West Africa) Ng'holongo, Kabili, and Wiru Ugogo have been used in crosses, as detailed in early reports. Once the required earliness of maturity coupled with a good grain has been obtained, intercrossing is to be done, both deliberately and by means of panmixia, to give a much better range of variability for selection.

B.C. 27(2) × Msumbiji, first backcross.—Two hundred and five progeny rows from this cross were grown, and 147 fresh selections were taken from them. Many of these appeared to have good Msumbiji type grains, which, besides possessing a corneous endosperm, appear also to be relatively resistant to grain moulds. The lack of purple pigment in the Msumbiji plant is also a valuable character, since the grains do not develop purple blotches on being injured by sucking insects in the field. Many of the selections from this cross showed plants of this Msumbiji type.

Fifty-nine progeny rows of the F_2 generation of B.C. 27(2) × Msumbiji segregates crossed with B.C. 27(2) × Wiru segregates were grown, and seventy-five promising selections taken.

Dobbs (2) × Wiru, first backcross.—Two hundred progeny rows of the F_3 generation were grown, and yielded some good Dobbs type plants with corneous, Wiru type grains: 198 of these plants were selected.

B.C. 27(2) × Kabili.

B.C. 27(2) × Kabili, 1st backcross.

Oklahoma 44/14 × Kabili.

Oklahoma 44/14(2) × Kabili, 1st backcross.

Dobbs × Kabili.

B.C. 27 × Ng'holongo.

B.C. 27(2) × Ng'holongo, 1st backcross.

Oklahoma 44/14 × Ng'holongo.

Oklahoma 44/14(2) × Ng'holongo.

One hundred and seventy-five progeny rows of the F_2 , F_3 or F_4 generations were grown from these crosses. Some showed a high standard of grain, and many had useful goose-necks (see bird resistance below). Some of the Oklahoma × Kabili crosses looked particularly promising, being short, early, vigorous, and free from Aphis attack. These were crossed to the B.C. 2 Wiru strains 42B and 36D to which reference has been made.

B.C. 27(2) × Belko, first backcross.—Seventy-five progeny rows of the F_3 generation yielded seventy-nine good selections, many with the corneous Belko grain (alleged to be very resistant to weathering in West Africa), others with long awns, 10-15 mms., which may be of use against birds.

Several of these crosses have reached a stage when intercrossing in the 1955-56 season will be worthwhile.

(2) *Bird Resistance.*

The palatable grains being developed are very much liked by small grain-eating birds in the green stage, but ripe and hard grains are not liable to damage from small birds. The next objective of the breeding programme is to assemble in the same plant characters which will make it difficult for birds to take much of the grain; a combination of goose-neck, large glumes, and long awns is being developed in an attempt to achieve this.

Counts on rows with palatable grains, segregating for goose-neck, showed that some 50 per cent of the grain escaped damage, whereas the erect heads in the same rows were practically stripped.

Work is less far ahead in estimating the usefulness of the large glumes, but it is clear that it is the relative sizes of glume and grain which matter: a large glume which does not completely enclose the grain is of little value.

A good range of awns is now available on the early maturing material, but it seems clear that 15 mms. is the longest which can be obtained at present, and that by themselves awns will be very little discouragement to birds.

Goose-neck.

B.C. 27 × Korgi.

B.C. 27(2) × Korgi, 1st backcross.

Oklahoma 44/14 × Korgi.

Oklahoma 44/14(2) × Korgi, 1st backcross.

Dobbs × Korgi.

Four hundred and sixteen progeny rows of these crosses were grown, mainly F_3 and F_4 generations. A number of lines gave a high proportion of goose-necks on very promising plants, others gave large grains, and a few were retained for this character. The number of lines was reduced to ninety-seven of the best goose-neck and large grain strains. Reference has been made to the goose-neck lines from Ng'holongo and Kabili crosses.

53 × Crosses.—These crosses were made between various early maturing goose-neck segregates and some of the B.C. 2 Wiru lines. Two hundred and thirty-nine of the F_3 progeny rows were grown, and 235 selections for goose-neck

with some corneous layer in the grain were made. The grain standard was not good enough, so twenty-six of the best goose-neck lines were crossed to the B.C. 2 Wiru lines 36D, 42B and 23B.

Large glumes.—Feki Mustahi, a Sudan variety with very large glumes, had been crossed and backcrossed to some of the 53× lines. Two hundred and sixty-seven F₂ and F₃ progeny rows from these crosses were grown, they yielded a number of plants with very large glumes, some with goose-necks, and many with a fair standard of white corneous grain. Four hundred and seventeen selections were made and forty of the most promising plants with the largest glumes were crossed to the B.C. 2 Wiru lines 42B, 36D and 23B.

The large glume obtained as a segregate from the cross (B.C. × Wiru) × (B.C. × D.D. Shallu) was crossed to B.C. 2 Wiru lines 42B and 36D, and the F₁ generation grown out. This large glume was dominant in the cross, whereas that of Feki Mustahi behaves as a recessive character.

The stage has now been reached when the goose-neck can be coupled to the large glume via the B.C. 2 Wiru lines having the best corneous grains.

Awns.

B.C. 27(2) × Nandayal Poona.

Dobbs × Nandayal Poona.

Thirty-four progeny rows of these crosses were grown, and thirty-eight selections with the relatively long stiff Nandayal Poona awn were taken. Reference has already been made to the long awn in the Belko crosses, and other good awns have appeared in some of the Korgi crosses.

(3) *Striga resistance.*—Fifteen of the selections from Dobbs were grown out at wide spacing on land heavily infested with Striga, and twenty-six selections of vigorous plants with no Striga showing above ground on them were taken. This work has now reached a stage when these selections can be compared with the ordinary bulk Dobbs.

(4) *Summary of the Breeding work.*—Good progress has been made in producing a range of early maturing material with palatable, weevil resistant grains, and it will only be a matter of time before a useful range of such varieties is available. The problems of bird-resistance are now receiving attention and it will be possible to devote more time to Striga resistance problems.

It should be mentioned that many of the introduced varieties in use as parents, especially those of Sudan origin, are far more subject to Aphis attack than local material, and a good deal of back-crossing to local material is needed to get the required standard of health and vigour.

(B)—SORGHUM EXPERIMENTAL

The district plot variety trials gave the following results:—

Yields of grain in lb./acre							
Plot				Mabuki	Lubaga	Butulwa	
Date planted				30.12.54	17.12.54	8.12.54	
Variety:							
SUK. 1	...	...	...	980	260	...	595
B.C. 27	...	...	...	1,045	95	...	410
Dobbs	...	...	...	1,060	490	...	1,010
Bakura Mahemba	...	...	...	750	400	...	295
Sign. diff. P=0.05	...	...	...	240	75	...	100

The rainfall at Mabuki was quite good, rather sparse in the early part of the season at Butulwa, and very poor for the first part of the season at Lubaga. The Ilula plot was so troubled by birds at planting and harvest that yields are not worth quoting.

Striga counts are available from Mabuki, as follows:—

MABUKI PLOT				
Variety	No. of Striga plants per acre (above ground) in the variety trial			
SUK. 1	...	...	...	7,020
B.C. 27	...	...	...	5,945
Dobbs	...	...	...	390
Bukura Mahemba	...	...	...	16,385

Once again the suitability of Dobbs as a sorghum for this area is demonstrated: it has yielded consistently well over six seasons in the district plots, and has always shown a low incidence of Striga. It is a pity that its grain is so poor.

The old Striga trial grew badly, and showed a lot of head smut; it has been under sorghum continuously for ten years, and would probably benefit from rest for a couple of seasons.

Results were as follows:—

OLD STRIGA TRIAL (Yields in lb./acre)				
		Striga pulled		Striga not pulled
Bakura Mahemba	...	...	195	77
Dobbs	...	...	120	119

(C)—RICE

No fresh selection work was done, but the filtering of selections made in previous years, through variety trials, was continued. A number of the more promising strains were distributed for observation to various parts of the territory.

Extract from the trials are given below:—

Variety trial A		25 strain balanced lattice			
Selection	Origin	Yields lb. per acre	Straw Strength	Shedding	Grain Quality
1/166 Afaa Kilombero	...	2,415	Very Good	Good	Medium
1/123 Afaa Mwanza	...	2,330	Medium	Medium	Medium
0/906 Afaa Kilombero	...	2,260	Very Good	Good	Medium
1/104 Afaa Mwanza	...	2,220	Good	Good	Medium
1/196 Afaa Kilombero	...	2,185	Good	Good	Medium
0/821 Afaa Kilombero	...	2,140	Good	Good	Medium
1/158 Afaa Mwanza	...	2,075	Good	Good	Medium
1/133 Afaa Mwanza	...	2,010	Medium	Very Good	Poor
49/48 Demarara Creole	...	1,715	Poor	Very Good	Very Good
Kahogo Control	...	1,960	Medium	Medium	Medium

Significant Difference ($P = 0.05$) 190 lb. per acre.

Variety trial B.		Randomised Block, 9 strains, 6 replications			
Selection	Origin	Yields lb. per acre	Straw strength	Shedding	Grain Quality
0/606 Sindano	...	1,970	Poor	Very Good	Poor
0/730 Afaa Mwanza	...	1,930	Very Good	Good	Medium
0/898 Afaa Kilombero	...	1,910	Good	Poor	Medium
0/760 Afaa Mwanza	...	1,660	Very Good	Poor	Medium
0/758 Afaa Mwanza	...	1,635	Good	Poor	Medium
0/146 Kahogo	...	1,630	Poor	Very Good	Medium
0/337 Sena Mtebe	...	1,580	Poor	Good	Medium
49/42 Demarara Creole	...	1,525	Poor	Good	Good
Kahogo Control	...	1,480	Medium	Medium	Medium

Sign. diff. ($P = 0.05$)

Variety trial C.

		25 strain balanced lattice					
Selection	Origin	Yields lb. per acre	Straw strength	Shedding	Grain Quality		
2/214 Afaa Kilombero	...	2,540	Very Good	...	Good	...	Poor
0/875 Afaa Kilombero	...	2,345	Good	...	Medium	...	Poor
2/229 Afaa Kilombero	...	2,275	Good	...	Poor	...	Good
2/190 Afaa Mwanza	...	2,265	Medium	...	Good	...	Poor
2/129 Meli I	...	2,175	Good	...	Good	...	Poor
2/87 Demarara Creole	...	2,170	Poor	...	Very Good	...	Good
2/141 Meli II	...	2,140	Very Good	...	Poor	...	Medium
2/94 Demarara Creole	...	2,110	Poor	...	Very Good	...	Good
Kahogo Control	...	2,140	Medium	...	Medium	...	Medium
Sign. diff. (P = 0.05)	...	235					

Variety trial D.

		16 strain balanced lattice					
Selection	Origin	Yields lb. per acre	Straw strength	Shedding	Grain Quality		
2/217 Afaa Kilombero	...	2,075	Very Good	...	Poor	...	Poor
1/159 Afaa Mwanza	...	2,000	Very Good	...	Poor	...	Poor
2/208 Afaa Kilombero	...	1,950	Good	...	Poor	...	Poor
2/203 Afaa Mwanza	...	1,700	Good	...	Poor	...	Poor
2/257 Afaa Kilombero	...	1,600	Good	...	Medium	...	Poor
2/100 Demarara Creole	...	1,525	Poor	...	Very Good	...	Very Good
2/29 Kilima	...	1,495	Medium	...	Good	...	Poor
1/380 Demarara Creole	...	1,475	Medium	...	Very Good	...	Medium
Kahogo Control	...	1,275	Medium	...	Medium	...	Medium
Sign. diff. (P = 0.05)	...	75					

The rice did not tiller so freely as usual this season, possibly owing to the sparse rainfall during the early stages, although irrigation water appeared to be sufficient.

Some of these selections would be worth trying in observation districts plots in the Lake Province. It is by no means certain that Kahogo is still the best variety from the grower's standpoint, and it is likely that some selections will prove more satisfactory. Two of the Demarara Creole selections, 49/42 and 49/48, have been sent to a few areas for observation.

These trials, taken in conjunction with results given in previous year's reports, indicate that the selection programme has made satisfactory progress. There is now available a range of high yielding material, some with good straw, good for non-shedding, and with acceptable grain quality. The best combination of very good straw strength, very tightly held grain, and good grain quality has not yet been achieved, but the selection work is sufficiently far advanced to justify the commencement of a hybridization programme to obtain this end.

A. K. Auckland has now taken over the rice work, and will be able to give it more attention than it has received in the past.

ACKNOWLEDGMENTS

I am indebted to the Empire Cotton Growing Corporation staff on this station for much help in the work and to many members of the Department for their interest in the work, growing and commenting on sorghum seed from here, and for sending in seed of sorghum varieties.

REPORT OF THE AGRICULTURAL OFFICER (EXPERIMENTS), NJOMBE, SOUTHERN HIGHLANDS PROVINCE, FOR 1955

STAFF

Agricultural Officer (Experiments) was transferred to Njombe on 5th June to carry out his work from there instead of from Iringa.

In December the post of Agricultural Officer (Experiments) was abolished and experimental work is in future to be conducted by the staff of each district: Agricultural Officer, Njombe will however remain responsible for the planning of the 1956 programme and the analysis of Mbeya District experiments.

On 6th October Johannes Bagulamagida (Recorder Grade III) was transferred from Igumbiro Experimental Farm, Iringa, to establish the Development Unit at Wanging'ombe, Njombe District.

INTRODUCTION

This report is divided into three parts. All statistical experiments are included in either Part I—Cereals, or Part III—Pyrethrum, whilst Part II contains the reports on observation trials and Igumbiro Experimental Farm.

Generally speaking weather conditions were favourable to crop growth throughout the province except in the highest areas where prolonged rain or frost caused some damage. Rainfall was in most areas well distributed during its season.

The scope of work undertaken in 1955 was broad, and varied from complex experiments with pyrethrum to simple observation trials with new seed varieties. A total of forty-five statistical experiments were conducted at sites as far apart as Mbozi and Dabaga. In view of the difficulties in giving close supervision to all of them a reasonable quantity of reliable information has appeared from the years work.

CEREALS

Wheat.—In Mbeya District three variety trials and a manurial trial were carried out, the results of which fell into the pattern of previous findings. A high yield of over 3,000 lb. per acre was obtained at Uyole without fertilizer. The results of these trials are given in detail.

(1) *Uyole Variety Trial.*—Yields from this trial have again been high, although the previous highest yielding variety, 44/W/34 has dropped to sixth place. 34/W and 261 R were the fastest maturing and 361 B and Hope × Timstein were the slowest. The land was wet at planting which led to a delayed start later however most varieties thrived and no disease occurred. No fertilizer or manure was applied and the following mean yields were recorded:—

Variety	Yield lb. per acre
291 J III	3,060
356 A 4C	2,740
261 R 7C1B	2,620
44/W/1	2,600
294 B 2A3	2,440
44/W/34	2,380
358 P 3D	2,060
Hope × Timstein	1,800
361 B 1A1B	1,020

A significant difference between 2 yields is 500 lb. at 5 per cent Probability.
The standard error of a single plot is 14.3 per cent.

Conclusions.—On this season's showing 291J1I1 has significantly out-yielded the last five varieties, whilst 356A4C, 261R and 44/W/1 have out-yielded the last three. 361B1A1B yielded significantly lower than all others and should be discarded at Uyole. In comparison with previous trials it seems as if 34 W 44 cannot be relied upon to the extent that was previously thought but over the six years either this variety or 291J1I1 has held first place each time. Recommendations to farmers should therefore be that they should grow both varieties expecting one to give high yields and the other medium yields.

(2) *Uyole Manurial trial.*—The trial was planted a week later than the Uyole variety trial (10th March) when the land was less wet. It received no setback as a result and growth was normal throughout. Manure was applied at the rate of 0, 4 and 8 tons per acre to plots of 44/W/34, 294B2A3 and 184P2A1F to see whether the high yields at Uyole could be even further increased. Results show no response whatever to manurial application and the following mean yields were given by the three varieties:—

Variety	Yield lb. per acre	
184P2A1F	2,340	A significant difference is 282 lb. per acre.
44/W/34	2,280	Standard error is 15.3 per cent
294B2A3	1,700	

Conclusion.—294B2A3 yielded significantly less than either of the other varieties. It is worth noting that the yield of 44/W/34 in this trial is almost the same as in the variety trial, but that 294B2A3 has yielded less well.

As regards manurial application it appears that even after five years arable cultivation no immediate returns from manure can be expected. The soil of Uyole is known to be unusually fertile.

(3) *Njiapanda variety trial.*—A dressing of 9 tons per acre of manure was applied to the whole experiment of 10th February and planting took place on 4th March. Weather conditions were favourable throughout the growth of the crop and no setbacks occurred. Harvesting took place between 5th September and 4th October 291J1I1, 341F2D1 were latest.

The following yields were obtained:—

Variety	Yield lb. per acre
1066	2,200
362B1E1	2,000
362B1A4	1,900
291J1I1	1,860
341F2D1	1,820
362A	1,680
341F2D2	1,600
R54	1,100

A significant difference between two yields is 460 lb. acre.

Standard Error of a single plot = 17.3 per cent

Conclusion.—1. 1066 is significantly better than 362A, 341F2D2 R64 (at 5 per cent point).

2. R54 is significantly worse than all other varieties grown.

It is worth noting that out of the previously grown varieties 291J1I1 again took the lead, but that three of the new types this year yielded better (although not significantly so). 1066 and the 362 varieties should definitely be tried again.

(4) *Mbozi Variety Trial.*—Again grown without fertilizer, this trial has yielded very poorly. Sown in the last week of February, under rather wet conditions,

germination and early growth was patchy and uneven. The crop never looked promising. No rust or other set-back was recorded. The following yields were obtained:—

Variety	Yields (lb./acre)	Previous Record
358B3C	880	New Variety
44/W/34	634	2 firsts, 1 third
Hope × Timstein	563	New Variety
261S10C2D	550	1 first
294B2A3	524	1 third, 2 fourths
184P2A1F	524	—
Kenya Settler	466	—
RL2150A	359	—
361B1A1B	220	—

A significant difference is 356.6 lb. per acre (at 5 per cent).

Standard Error of single plot = 41 per cent.

Conclusion.—358B3C significantly out-yielded the bottom five varieties (at 5 per cent point). 44/W/34 and Hope×Timstein significantly out-yielded 361B1A1B (at 5 per cent point). On the showing of this and previous trials at Mbozi it is quite impossible as yet to recommend any variety as suited to the area. 44/W/34 has, on average done best over the four years, but it is very poor best.

In the last two seasons the poor yields have been attributed, probably correctly, to the lack of fertilizer dressing. Results have shown however that the coffee sub-station area is very far from being naturally suited to wheat production. Since a number of farmers are seriously considering wheat as a main crop in Mbozi it is considered worthwhile to include the following table showing the results of the best varieties grown there in the Agricultural Departments' experiments so far:—

VARIETY TRIALS AT MBOZI 1952-55

Season	1952	1953	1954	1955
Fertilizer applied	200 lb. Dutch Mixture	105 lb. Dutch Mixture—50 lb. Sulphate of Ammonia	None	None
44/W/34	1,677 X	1,716 X	319	634
338AA1A2	1,650	1,029	—	—
291J1I1	1,430	1,513	299	—
294B2A3	1,294	1,293	275	524
350AD9C2	1,100	1,188	143	—
261S10C2D	—	—	341 X	550
358B3C	—	—	—	880 X
Hope × Timstein	—	—	—	563

X Highest yield.

Although each year reasons have been found to explain the poor yields obtained. the above record is not a good one for a "potential" wheat area.

In the coming season a very full range of variety, time of planting and fertilizer trials are to be conducted in the area.

(5) Summary of Mbeya District variety trials.

HIGHEST YIELDS FROM MBEYA DISTRICT VARIETY TRIALS OVER 6 YEARS lb. per acre

Centre	1950	1951	1952	1953	1954	1955	Mean
Uyole... ..	2,560 (291)	2,290 (K.S.)	2,550 (291)	3,263 (44W)	2,850 (44W)	3,060 (291)	2,762
Njiapanda	2,220 (291)	1,720 (291)	1,839 (341)	2,650 (341)	2,375 (341)	2,200 (1,066)	2,167
Mbozi	—	—	1,677 (44W)	1,716 (44W)	341 (261)	880 (358)	1,153

Note:—Variety which gave highest yield is given in brackets below its yield.

MAIZE

Three trials were carried out this year to investigate the effects of leguminous green manures on a succeeding maize crop. Two of these were run at Igumbiro experimental farm in Iringa District, and one at Mbozi. At Igumbiro results of the two trials were somewhat conflicting, but a very clear advantage appeared from the velvet bean treatments in one trial, which showed an increase of over 2,000 lb. yield per acre compared with plots where maize was grown last year.

In a cultivation trial at Igumbiro it was found that no significant difference in yield resulted between planting maize on ridges or on the flat. Hyperphosphate was compared with super phosphate in a trial at Kibena in Njombe District. Results showed a distinct financial advantage in favour of Reno hyperphosphate application.

(1) *Maize Rotation Trial—Iringa.*—Rainfall from planting to harvest—21.44 inches in sixty-three days. This trial was established to test the effect of alternating maize crops with velvet bean or a velvet bean and sunn hemp green manure as compared with growing maize continuously. The trial also included an investigation of the effects of 200 lb. of super phosphate (40 per cent) and five tons of manure per acre applied every second year.

In 1954 the green manure treatments were planted on their appropriate plots on 13th January and were ploughed in during the first week of May. A dense cover was produced in every case.

This season all plots were planted with Eckstein maize on 13th December, 1954, the manurial treatments having been applied. The crop grew well, showing obvious treatment differences from early in its development. DDT powder was applied in January to control Stalk-borer. No significant response to either manurial or phosphate application was found but the differences due to green manure being grown in the previous year were marked.

MAIZE ROTATION TRIAL: MEAN YIELD DUE TO ROTATION TREATMENTS

Treatment 1954						lb. per acre after shelling Maize yield 1955
Maize	...	...	...	...	...	3,130 lb.
Velvet bean green manure	...	...	...	...	...	5,900 lb.
Velvet bean × sunn hemp G.M.	...	...	...	...	...	5,370 lb.

A significant difference at 5 per cent is 636 lb. per acre.

Standard error of single plot is 16.7 per cent.

Conclusion.—The increase in yield due to green manures of the previous year are significant at the 1.0 per cent point of probability. There is no significant difference between the effects of the velvet bean and velvet bean × sunn hemp mixture.

It appears from the results of this trial so far, that compared with growing maize in the area two years running an alternate year maize crop can be increased by 30 to 50 per cent by resting the land under a velvet bean green manure crop in the preceding year. The response to such treatment greatly exceeds that due to either an application of manure or superphosphate or both. The experiment is to be continued under the same alternate year system.

(2) *Maize—green manure trial—Iringa.*—Rainfall from planting to harvest: 21.44 inches in sixty-three days. The object of this experiment was to compare the effects of different harvesting treatments of a velvet bean crop on the following years' maize crop. In 1954 the following treatments were applied:—

- (a) Land left to a weed fallow—(control ploughed in May).
- (b) Velvet bean planted on 23rd January and ploughed in at flowering in early May.
- (c) Velvet bean planted on 23rd January and cut for hay in early May.
- (d) Velvet bean planted on 23rd January and seed harvested in late July.

This season Eckstein maize was planted on the 13th December. Cultivations and treatments identical to those for the rotation trial were carried out. No manure or fertilizer was applied. Harvesting took place on 31st May when the following yields were recorded:—

1954 Treatments	1955 Maize yields
Control	4,384 lb. per acre
Bean ploughed in at flowering	4,144 " " "
Bean cut for hay	3,344 " " "
Bean seed harvested	3,144 " " "

A significant difference at 5 per cent probability is 751.2 lb. per acre.

Standard error of a single plot is 13.3 per cent.

Conclusion.—The removal of velvet bean green matter (Treatments 3 and 4) has led to a significant decrease in yield below the effect of a weed fallow and ploughing in treatments. Furthermore there has been no significant increase in yield due to any velvet bean treatment over the yields obtained from the weed fallow plots. These results were somewhat surprising and seem to indicate that resting the land under weed fallow and ploughing the green matter in in May is just as good as sowing a velvet bean crop for ploughing. Certainly the results of all treatments indicate that the benefit derived from such a green manure is in this case due solely to the leafage rather than to the root system and nodule bacterial that may be left in the soil. Hence green weeds are as good as velvet bean and the removal of foliage altogether actually depressed fertility.

(3) *Iringa maize cultivation: (A Cut/M/SH/IG/4/55).*—Rainfall from planting to harvest 21.29 inches in sixty-two days. This was a small experiment conducted to determine what effects ridging had on a maize crop. Eckstein maize was planted on 15th December and the following yields were obtained on 10th June, after the crop had grown normally and evenly:—

Treatments	Yield lb. per acre
Planted on the flat in 3 feet rows	3,670
Planted on ridges at 3 feet apart	3,180
Planted on flat and ridged when plants were 9 inches high	3,130
Planted on flat and ridged when plants were 18 inches high	2,920

The standard error of a single plot was 10.9 per cent.

No difference between treatments was significant.

Conclusions.—The experiment was reasonably accurate and it may be assumed that whether maize is planted on ridges or on the flat has very little effect on its ultimate yield. Growers can therefore be assured that by ridging to conserve soil they will not lose any yield.

(4) *Maize Hyperphosphate trial: (Fert/MSH6/55 Njombe District).*—Rainfall from planting to harvest 28.25 inches in sixty-seven days. Hickory King Maize was sown on 25th December with the treatments shown in the table below. Apart

from an infection of pink ear rot on a few plants spread evenly over the trial growth was normal. The object of the trial was to compare responses to Superphosphate and Reno-hyperphosphate. (A new form of treated rock phosphate from North Africa).

Harvesting took place on 8th August. Yields were disappointingly low and stems averaged just under one cob each this however was experienced with most of the maize crop in the area.

MEAN TREATMENT YIELDS OF MAIZE RENO-HYPERPHOSPHATE TRIAL

Treatment	Shelled Yield	No. of Cobs per acre	No. of plants per acre
Control	861	6,900	8,500
130 lb. Hyperphosphate (approx. 40 lb. total P_2O_5) ...	1,216	8,400	9,080
270 lb. Hyperphosphate (approx. 80 lb. total P_2O_5) ...	1,303	7,900	8,300
200 lb. Superphosphate (40 per cent) (approx. 80 lb. total P_2O_5)	1,389	8,700	9,800
100 lb. Superphosphate (40 per cent) (approx. 40 lb. total P_2O_5)	1,456	8,300	9,600
200 lb. Hyperphosphate (approx. 60 lb. total P_2O_5) ...	1,506	8,300	9,600
150 lb. Superphosphate (40 per cent)	1,734	9,100	9,600

A significant difference between two treatments yields is 360 lb. per acre.

The standard error of a single plot is 20.2 per cent.

Conclusion.—(a) All plots with a fertilizer treatment significantly out-yielded the control plots with the exception of the 130 lb. level of hyperphosphate which is on the borderline of significance.

(b) The 60 lb. levels of P_2O_5 in both hyper and superphosphate treatments gave the best response and there was no significant difference between the two. They significantly out-yielded the 40 and 80 lb. P_2O_5 levels of hyperphosphate.

(c) The decrease in the yield at the 80 lb. P_2O_5 level below the 60 lb. level is significant for hyperphosphate and nearly so for superphosphate. This is becoming a common result in experimental work, in the Njombe District and next season a series of micro-nutrient trials are to be run to see whether trace element status has any bearing on this.

(d) There is no significant difference between treatments for number of cobs per acre or number of stems.

It appears from this trial that a similar, and optimum response can be obtained from both 200 lb. of hyperphosphate and 150 lb. superphosphate, and that in this case both applications just about doubled the yield obtained without fertilizer.

The following costings show a clear economic advantage in favour of hyperphosphate. (Figures are based on price quotations by the Tanganyika Farmers' Association in December, 1955).

	Cost	
	Iringa Shs.	Njombe Shs.
150 lb. Superphosphate	60/-	63/-
200 lb. Hyperphosphate	44/-	47/-

This experiment showed that either of these applications per acre doubled maize yield.

SORGHUM

Iringa Sorghum Reno-hyperphosphate trial.—Rainfall from planting to harvest 17.39 inches in fifty-five days. The trial was planted on 11th January with Enyanza sorghum: germination however was very patchy and on 3rd February

gaps were filled with transplants. Growth was uneven throughout which led to a high standard error. Uneven growth such as this had been noted in previous years at Igumbiro and attributed to variations in soil fertility. The object and treatments were similar to those of the maize hyperphosphate trial, superphosphates and hyperphosphates responses being compared.

MEAN TREATMENT YIELDS FROM SORGHUM RENO-HYPERPHOSPHATE TRIAL

	Yields lb. per acre			
Control	...	...	...	3,460
130 lb. hyperphosphate	...	...	...	3,440
200 lb. superphosphate	...	...	...	3,440
150 lb. superphosphate	...	...	...	3,160
100 lb. superphosphate	...	...	...	2,980
200 lb. hyperphosphate	...	...	...	2,500
270 lb. hyperphosphate	...	...	...	2,100

A significant difference between two treatments yields is 954 lb. per acre.

Standard error of a single plot 23.6 per cent.

Conclusion.—No treatment yielded better than control and the two highest levels of hyperphosphate applications caused a significant decrease in yield (at 5 per cent probability).

There seems to be no reasonable explanation for these results unless the experiment was sited on land which had previously received special treatments. In any case it is undoubtedly better to disregard the trial, unless other experiments show similar results, and to assume that yields here are due to some very localized peculiarity in the soil.

OBSERVATION TRIALS AND GENERAL CROPS

Groundnuts—Iringa District.—Two observation trials were conducted this season at Igumbiro to test forty new varieties from Kongwa and three from South Africa against Valencia, the standard variety grown at the experimental station.

Results from the most outstanding types were as follows:—

"KONGWA" GROUNDNUTS OBSERVATION TRIAL: YIELD LB. PER ACRE

Variety	Unshelled Yield	Shelled Yield	Size of Nut	Harvesting Date	Origin	Growth Habit
1. B353	1,624.9 ...	905.8 ...	Medium ...	14.6.55 ...	Kampala ...	Upright
2. B713	1,566.0 ...	795.1 ...	Small ...	22.6.55 ...	Kampala ...	Upright
3. BB2	1,521.1 ...	822.8 ...	Medium ...	14.6.55 ...	Kampala ...	Upright
4. Gambia Bunch	1,503.9 ...	767.5 ...	Small ...	23.6.55 ...	Nyasaland ...	Upright
5. 1838 Stephen v.	1,486.6 ...	981.8 ...	V. small ...	21.6.55 ...	U.S.A. ...	Upright
6. B727	1,452.0 ...	836.6 ...	Medium ...	13.6.55 ...	Kampala ...	Upright
7. Natal Common	1,244.0 ...	698.3 ...	Small ...	13.6.55 ...	Sudan ...	Upright
8. K. Red	1,140.8 ...	497.8 ...	Large ...	28.5.55 ...	Kongwa ...	Upright
9. B704	1,123.6 ...	636.1 ...	Medium ...	23.6.55 ...	Kampala ...	Upright
10. A 14	1,123.6 ...	708.7 ...	V. Large ...	25.5.55 ...	B. Congo ...	Upright
11. A 21	1,106.3 ...	600.2 ...	Large ...	14.7.55 ...	B. Congo ...	Spreading
Valencia	633.2 ...	382.3 ...	Medium ...	23.6.55 ...	Est. Igumbiro ...	Upright

YIELDS FROM SOUTH AFRICAN VARIETIES

Variety	Unshelled Yield	Shelled Yield	Size of Nut	Harvesting Date	Origin	Growth Habit
Masambika Natal	1,002.6 ...	553.1 ...	Large ...	24.6.55 ...	S. Africa ...	Upright
Common	691.4 ...	432.1 ...	Large ...	24.6.55 ...	S. Africa ...	Upright
Alpha	432.1 ...	259.3 ...	Large ...	24.6.55 ...	S. Africa ...	Upright

Conclusion.—To draw any hard and fast conclusions from the results of one season's work would be unwise, but it is probably safe to assume, that on land similar to Igumbiro Farm varieties Nos. 16 to 40 of the "Kongwa" types can be discarded as probably unsuitable owing to poor germination and the three South African types should not yet be discarded. It should be noted that more than half the varieties grown did better than the previously grown "Valencia".

There are several upright types producing good yields of small nuts which should undergo further trial unless there is too much risk of their becoming infected with mosaic virus. As regards spreading varieties, and those which produce good yields of larger nuts, the choice is likely to be much more limited. K. Red and A14, both upright types, produced a very fine nut in good quantity; whilst the spreading varieties A21, S723 and Kartum yielded well enough to be of further interest—all three of these produced large nuts. It seems probable that the medium term are the ones best suited to Iringa conditions.

Cassava—Igumbiro Farm.—All varieties have grown well this season with the exception of 4026/16 on which Brown Streak was identified late in the year. No cassava was harvested during the year, the twelve varieties planted in 1954 were retained (except those showing Brown Streak) as a source of planting material, from which a variety trial was established on 22nd December, 1954 and further bulking plots in February, 1955.

About 2,000 cuttings were supplied to Mbeya District early in the year.

Sweet Potatoes—Igumbiro Farm.—A plot of Caroline Lee was retained throughout the season as a source of planting material. Cuttings were sent to Dabaga and to Njombe Districts.

Cowpeas—Igumbiro Farm.—Dr. Saunders' upright has been grown at Igumbiro for several years and 1½ acres were planted this season. Growth of the crop was good and good quality beans were harvested. A half acre planted on 8th February and harvested on 23rd May yielded 1,200 lb. of beans per acre. One acre planted on 19th February and harvested on 10th June yielded 660 lb. per acre. Neither crop received any fertilizer or manure.

Lupins—Igumbiro Farm and Kibena (Njombe District).—*Bitter White.*—About a quarter of an acre of this variety was sown on 11th February at Igumbiro and 167 lb. of seed were harvested on 22nd July. The crop did not grow exceptionally well and was considered to produce too little leaf to be ideal as a green manure. Germination however was good and plant growth even.

They were found to be highly successful as a green manure on the Colonia Development Corporation's farm at Kibena. The crop grew better than in the Iringa District. The variety is now being used on a commercial scale in the farming system.

Soya Beans—Igumbiro Farm and Kibena (Njombe District).—Just under half an acre of an unknown variety, previously grown at Igumbiro, was planted there again this season on 1st February. The yield was approximately 320 lb. per acre. No fertilizer was applied. The crop never looked particularly promising and only grew to a height of about twelve inches. Yellowing of the leaves occurred at an early stage.

On the Colonial Development Corporation's farm at Kibena the unknown variety was tried as a possible cash or green manure crop. Results were superior to any previously grown legume and the crop is to be grown on an economic basis in 1956.

Castor Seed—Igumbiro Farm.—A new variety, Hungarian Dwarf, was tried this season and grew well. Height was about 2 feet 6 inches or 3 feet. A good sample of beans was harvested from 16th May onwards.

Local Beans—Igumbiro Farm.—Some three-quarters of an acre of local beans were planted on 31st January and harvesting was completed by 16th May. The crop grew well and was unhindered by pests or disease; it yielded about 880 lb. per acre.

Sorghum—Igumbiro Farm.—*Enyanza*—approximately three acres were planted between 12th and 14th January which yielded an average of 2,500 lb. per acre between 17th June and 4th July. There is little doubt that this variety is well suited to this area. It has done consistently well over the last three years.

Maize—Igumbiro Farm and Kibena (Njombe District).—(a) Eckstein: approximately eight acres were planted at Igumbiro between 16th and 24th December, 1954. These yielded an average of approximately 1,900 lb. per acre without fertilizer or manure. The crop was not entirely even in its growth and two dressings of 2.5 per cent DDT powder had to be applied to control Stalk Borer attack. Harvesting took place between 11th and 28th June.

(b) *Katumbili*: Approximately $3\frac{1}{2}$ acres were planted at Igumbiro on 21st and 22nd December. These yielded an average of 1,400 lb. per acre during the first week of June.

(c) At the Tanganyika Wattle Estates farm at Kibena Hickory King was planted as the main crop but yielded poorly, an average of only $3\frac{1}{2}$ bags per acre being produced. This was believed to be due partly to heavy incidence of Pink Ear Rot and partly to the lack of alternative crops in the rotation.

ACKNOWLEDGMENTS

Experiments at Mbozi were supervised by the Agricultural Officer, Mbozi and those in the remainder of the Mbeya District by Field Officer (Agriculture), Mbeya.

The writer particularly wishes to express appreciation for the help given by Tanganyika Wattle Estates in running the Reno-hyperphosphate trial, and to other farmers also concerned with experiments on cereals.

J. R. TUCKETT,
Agricultural Officer

PYRETHRUM EXPERIMENTS, 1955

INTRODUCTION

The Uwemba Farmers' Association has this year widened its scope of experimental work to include the South Uwemba area, which lies some twenty miles south-west of the older farms. New farms in South Uwemba undertook five trials mainly to investigate fertilizer responses there.

Co-ordination of all the experimental work between farmers and the department has again been of a high standard. Twenty new trials were started during the season and a reasonable standard of accuracy has been maintained in most of them. Seven trials which were continued from previous years are all due to finish this season. Most of these had already given the information required of them; in this, their final year, they have yielded little fresh data and, as appears inevitable with older pyrethrum, they have decreased in accuracy.

The season has, on the whole, been favourable. A ten-day break in the rains during January caused some postponement of planting, but after that more rain than usual fell in March, April, May and June: distribution was good. Mists and drizzle lasted into July and early August. Severe ground frost was recorded between 10th and 16th August, and air temperatures fell to at most 32 degrees F. Except in localized areas where frost was so severe as to seriously set back the plants, flower production appears to have been stimulated and an exceptionally heavy flush was harvested in November. This is in line with experience in Kenya.

SUMMARY OF THE YEARS WORK

A series of identical experiments run on eight different soil types has shown remarkable variation between the inherent fertility of soils, and in their responses to superphosphate application. On the whole, soils containing volcanic ash produce better yields, but this tendency is not as marked as the fact that freshly broken soils out-yielded previously cultivated land whether phosphate and manure were applied or not. Most soils show a significant response to superphosphate application but it is common to find that the 200 lb. per acre application is not better than the 100 lb. rate. Manurial treatments have given significant responses on eight soil types.

Mulching has this year given virtually no response on any of the eleven experiments in which it was included.

Nitrogen applications have once again not resulted in any increase of yield, even in the presence of phosphate.

Two hundred pounds of poultry manure per acre has given an increase of yield of 50 lb. per acre comparable to that given by superphosphate and manure in other trials.

Reno-hyperphosphate has given results which show that on at least one soil type it will give similar increases to those due to superphosphate for the same cost of application.

Irrigation of pyrethrum at the rate of two inches of water per fortnight has resulted in a yield increase during October and November amounting to 76 lb. of flowers per acre.

EXPERIMENTS IN PROGRESS AND CONTINUING

Soil Type Experiments: 1st Season.—Since earlier work at Uwemba had shown rather variable results with regard to pyrethrum growth and response to applied nutrients on different farms, it was decided to run a large scale experiment covering eight of the main soil types in the area (Geological Survey Report No. AMMS/26 by Spurr) with the object of finding out the value of superphosphate, manurial and mulch applications in relation to soil type.

The experiment, consisting of eight $3 \times 3 \times 3$ factorial trials, was laid down and planted in January, 1955, on the following soils:—

70A. Pany's Ash Soil	...	...	...	...	(E. Rowland, Esq.)
70B. Dathan's Ash Soil	...	...	...	...	(Commander J. H. Dathan)
70C. Notcutt's Ash Soil	...	...	...	...	(Col. L. A. Notcutt).
70D. Togni's Ash Soil	...	...	...	...	(A. Togni, Esq.).
70E. Bayldon's Red Soil	...	...	...	...	(The Hon. I. C. Bayldon, M.L.C.).
70F. Pany's Red Soil	...	...	...	...	(E. Rowland, Esq.).
70G. Bayldon's Yellow Soil	...	...	...	...	(M. B. Davidson, Esq.).
70H. Dansland Valley Soil	...	...	...	...	(T. H. Patel, Esq.).

Of these it was considered unlikely that Bayldon's yellow or Dansland Valley soil would produce an economic crop; they were included in the trial however to see whether poor soils of this sort could yield a reasonable crop with fertilizer application. It was expected that the four ash soils, would, on the whole, yield better than the non-ash types. A further comparison in the experiment was between newly cultivated soils (two of which were ash types and two non-ash) and soils which had been under cultivation for at least four years and had grown a previous crop of pyrethrum.

Treatments applied were as follows:—

Manure: Applied under ridges early in December (about one month before planting) at 5 tons and 10 tons per acre.

Superphosphate: (40 per cent P_2O_5) applied in the planting holes immediately before planting, at 100 and 200 lb. per acre.

Mulch: Wheat straw laid on the plots at, or shortly after, planting. Either laid down between every row, or between alternate rows.

Each of the eight trials was recorded and analyzed separately yielding the following results:—

TABLE I
SOIL TYPE TRIALS—MEAN YIELDS FROM PHOSPHATE TREATMENTS—LB. OF DRY FLOWERS
PER ACRE

Soil type	Superphosphate 40 per cent			Significant Difference at 5% P
	None	100 lb./acre	200 lb. per acre	
70A Pany's Ash	467.5	652.0	561.5	64.5
70B Dathan's Ash	270.0	302.5	337.5	N.S.
70C Notcutt's Ash	426.0	483.4	512.8	53
70D Togni's Ash	175.1	232.9	294.0	32
70E Bayldon's Ash	186.0	233.2	296.1	44
70F Pany's Red	550.2	650.4	589.1	N.S.
70G Bayldon's Yellow	95.0	100.2	75.0	N.S.
70H Dansland Valley	181.1	232.8	242.0	32

TABLE II
SOIL TYPE TRIALS—MEAN YIELDS FROM MANURIAL TREATMENTS LB. OF DRY FLOWERS PER ACRE

Soil type	Farmyard manure			Significant Difference at 5 % P
	None	5 tons per acre	10 tons per acre	
70A Pany's Ash	470.0	590.0	621.0	54.5
70B Dathan's Ash	241.5	294.5	374.0	64.5
70C Notcutt's Ash... ..	433.0	454.2	535.3	53.0
70D Togni's Ash	225.0	227.2	250.9	N.S.
70E Bayldon's Red	246.1	208.3	261.2	N.S.
70F Pany's Red	562.2	589.8	630.0	N.S.
70G Bayldon's Yellow	54.4	95.2	115.0	N.S.
70H Dansland Valley	160.0	252.2	244.9	32

One significant response to mulch was obtained and this was only barely so.

Only three out of eight soils produced any significant interaction response, and there does not, in most cases, seem to be any noticeable trend due to interacting factors.

ANALYSIS OF THE COMPLETE SOIL TYPE EXPERIMENT

As was expected, a very highly significant difference appeared between soil types (at 0.1 per cent point of probability), and the mean yields of ash soils exceeded those of non-ash types by about 100 lb. per acre (ash types: 393 lb. per acre. Non-ash types 285 lb. per acre). There was an even more marked difference between yields from newly cultivated soils and those which had grown pyrethrum and other crops before.

TABLE IV
SOIL TYPE EXPERIMENTS—MEAN YIELDS FROM SOILS. LB. OF DRY FLOWERS PER ACRE

Soil types	Yield	Yield
Newly cultivated soils:		
A. Pany's Ash	572	New soil: 420 lb./acre
B. Dathan's Ash	304	
F. Pany's Red	600	
H. Dansland Valley	219	
Soils under cultivation for at least 4 years		
C. Notcutt's Ash	474	Old soil: 259 lb./acre
D. Togni's Red	234	
E. Bayldon's Red	238	
G. Bayldon's Yellow	89	

Significant difference = 50 lb./acre for P = 5%

Significant difference = 29.8 lb./acre for 5 % P.

Standard error of a single plot for whole experiment 25.2 per cent.

The analysis of interaction responses showed no interaction between ash soils and non-ash soils response to phosphate or to manure. There is however an interaction between old soil's and new soil's responses to both, as is shown in the following table:—

TABLE V
INTERACTION: MEAN YIELDS PHOSPHATE AND MANURE $\times$ OLD AND NEW SOILS. LB. OF DRY FLOWERS PER ACRE

	Newly Cultivated soils	Previously Cultivated soils
No phosphate	367	220
100 lb. superphosphate/acre	460	262
200 " " " "	433	292
No manure	360	239
5 tons manure per acre	442	246
10 " " " "	458	291

A significant difference at 5 % = 44 lb. per acre.

CONCLUSIONS DRAWN FROM THE FIRST YEAR OF THE SOIL TYPE EXPERIMENT

1. *Soils*.—Of the soil types tested in this experiment Pany's Red has appeared as by far the most inherently fertile, followed by Notcutt's ash and Pany's Ash. With the exception of Bayldon's Red and Togni's Ash which show remarkably similar fertility and fertilizer responses, all the soil types have given widely differing results and have shown very little agreement in their reaction to phosphate and manure. The greatest responses to superphosphate were given by Pany's Ash, Togni's Ash and Bayldon's Red and the highest responses to manure came from Pany's Ash, Dathan's Ash and Notcutt's Ash.

2. *Phosphate and Manurial treatments*.—All the soils except Dathan's Ash, Pany's Red and Bayldon's Yellow have responded significantly to phosphate application; and it is possible that Dathan's Ash and Pany's Red responses would have been significant had the trials been rather more accurate.

The fact however that on only two soils (Bayldon's Red and Togni's Ash) the 200 lb. level of superphosphate produced a significantly higher yield than the 100 lb. level, and that on Pany's Ash the higher rate of application yielded significantly lower than their lower rate, strongly suggests that some other limiting factor is coming into play at a rather lower phosphate level than might be expected. It is considered unlikely that this limiting factor is a climatic one, especially as the season was particularly favourable for pyrethrum.

Since there is a more distinct tendency for yield increases to fall away at the higher level of phosphate application on the newly cultivated soils (this is shown in Table V) it might seem likely that the limiting factor lay in the carbon/nitrogen ratio of the soil, and that lack of available nitrogen was impeding growth. This however seems unlikely because nitrogen application in the Uwemba area has not so far shown any yield increase either on new or old soils, even in the presence of phosphate.

A possible explanation may be that the micro-nutrient status of the soil is the limiting factor, either through a direct deficiency or through a reaction between a trace element and soil phosphates or nitrogen which is upsetting the nutrient balance in the soil. Peculiarities in phosphate response, and lack of response to nitrogen are by no means confined to this series of trials but have occurred throughout Njombe and Iringa Districts experimental work, it has therefore been decided to carry out exhaustive trials with trace elements in their relation to the major plant nutrients at Uwemba in 1956.

TABLE VI
RESPONSES TO PHOSPHATE AND MANURE IN THE SOIL TYPE TRIAL—LB. OF DRY FLOWER PER ACRE

Phosphate Treatments	Mean Yields from all Soil Types	Manurial Treatments	Mean Yields from all Soil Types
No Phosphate	... 293	No manure... ..	... 300
100 lb./acre superphosphate	... 362	5 tons/acre manure	... 344
200 lb./acre superphosphate	... 363	10 tons/acre manure	... 374
Significant difference = 30 lb./acre at 5% P.		Significant difference = 30 lb./acre at 5% P.	

Manurial responses are, on the whole, more consistent, and higher application has led to significantly higher yields on both Dathan's Ash and Notcutt's Ash, a pattern which is generally followed on the other soils which did not produce significant results.

The two soils which responded to both levels of superphosphate (Bayldon's Red and Togni's Ash) have given no significant response at all to manure, it can therefore be assumed that these two types are particularly lacking in available phosphate.

FERTILIZER REQUIREMENTS EXPERIMENT: (SOUTH UWEMBA)—FIRST SEASON

This trial is intended to run concurrently with the soil type trials of North Uwemba, and to serve as a guide to the application of these results to South Uwemba soils, especially with regard to phosphate and mulch responses.

Applications of nitro-chalk have been included here to find out whether this form of nitrogen has any effect on pyrethrum growth.

The trial was laid down as a $3 \times 3 \times 3$ factorial design with two replications and planted on 15th January, 1955. Mulch treatments were not applied until the beginning of April, shortly before the end of the rains.

TABLE VII

FERTILIZER REQUIREMENTS—SOUTH UWEMBA—MEAN YIELDS FROM MAIN TREATMENTS—LB. OF FLOWERS PER ACRE

Treatment	Yields	
No superphosphate	155	Significant at 1% point. Significant difference is 30 lb. per acre.
150 lb. superphosphate	245	
300 lb. superphosphate	280	
No nitro-chalk	235	Not significant.
150 lb. nitro-chalk	230	
300 lb. nitro-chalk	235	
No mulch	235	Not significant.
Light mulching (every row)	225	
Heavy mulching (every row)	215	

Standard error of a single plot is 18.7 per cent.

Conclusion.—(a) No interaction responses were significant.

(b) Superphosphate application has given an increase of 90 lb. of flowers per acre for the first 150 lb., but the further increase due to the 300 lb. application has only given a return of 35 lb. of flowers for the additional 150 lb. of superphosphate.

(c) Neither the mulch nor nitro-chalk treatments have given any response, even in the presence of phosphate. The mulch treatments might begin to give a response over a number of years and should be continued in this trial.

SUB-SOILING $\times$ POULTRY MANURE EXPERIMENT—FIRST SEASON

This experiment was designed as a 3×3 factorial with four replications to find out what response could be expected from poultry manure application, and to see whether sub-soiling with a Ferguson sub-soiler after ridging had any effect on the growth and yield of pyrethrum planted subsequently.

Poultry manure was applied in the planting holes immediately before planting on 18th January. Picking started on 12th July and continued at monthly intervals until 15th November.

TABLE VIII

SUB-SOILING $\times$ POULTRY MANURE—MEAN YIELDS OF MAIN TREATMENTS—LB. OF DRY FLOWERS PER ACRE

Treatment	Yield	
No Poultry manure	156.3	Significant at 0.1 per cent point. Significant difference is 34.5 lb. per acre
200 lb./acre poultry manure	204.2	
400 lb./acre poultry manure	231.3	
No subsoiling	180.4	Not significant
Subsoiling every 7 feet	212.3	
Subsoiling every 2 feet 4 inches	199.2	

Standard error of a single plot is 20.0 per cent.

Conclusion.—Response to the first 200 lb. of poultry manure is marked and has resulted in an increase of nearly 50 lb. of flowers per acre, there is however no further significant increase due to the 400 lb. application. Sub-soiling, as carried out on this trial, has had no effect. There is no significant interaction between sub-soiling and poultry manure application.

Indications are that poultry manure is likely to be a useful fertilizer for pyrethrum, and in the coming season it is to be compared with superphosphate and hyperphosphate.

RENO-HYPERPHOSPHATE TRIAL—FIRST SEASON

The trial was laid down to a seven treatment randomized block design with four replications, and was planted on 8th February, 1955.

Growth was rather slow in the early stages and pickings during July, August and September yielded practically nothing. In October, November and December however a reasonable crop was harvested.

TABLE IX

PYRETHRUM RENO-HYPERPHOSPHATE TRIAL—MEAN TREATMENT YIELDS—LB. OF DRY FLOWERS PER ACRE

Treatments	Yields	
270 lb. Hyperphosphate (Approx. 80 lb. total P_2O_5)	... 230.6	
200 lb. Superphosphate (Approx. 80 lb. total P_2O_5)	... 229.3	Significant difference between two yields is 68.0 lb. per acre.
200 lb. Hyperphosphate (Approx. 60 lb. total P_2O_5)	... 164.1	
150 lb. Superphosphate (Approx. 60 lb. total P_2O_5)	... 239.8	
130 lb. Hyperphosphate (Approx. 40 lb. total P_2O_5)	... 176.2	
100 lb. Superphosphate (Approx. 40 lb. total P_2O_5)	... 168.4	
No fertilizer	... 156.4	

Standard error of a single plot is 22.9 per cent.

Conclusion.—Hyperphosphate has again proved itself a very worthy competitor with superphosphate, having yielded as well at the 270 lb. level as superphosphate at the 150 and 200 lb. level: these treatments have all given an increase in yield of more than 70 lb. of flowers per acre.

At present prices however the cost in Njombe of 270 lb. of hyperphosphate is almost exactly the same as 150 lb. of superphosphate and hyperphosphate will not be a more economic fertilizer to use unless it is later found that either the 270 lb. application leads to higher yields still, or where a lower application produces results which are as good.

IRRIGATION TRIAL—FIRST SEASON

This experiment was designed by Col. L. A. Notcutt to determine whether irrigation during the dry season would result in a prolongation of the second (dry season) flush and thereby increase yields. A randomized block design of two treatments and three replications was used.

Irrigation began on 4th July at the rate of two inches per acre per fortnight, and continued until 20th December. Picking was carried out at monthly intervals from 15th July to 2nd January.

Irrigation plots yielded 165 lb. of dry flowers per acre and the non-irrigated 89 lb. This difference was significant (S.D.=73 lb. per acre at 5 per cent point of probability). There was however no difference at all between yields until the picking on 25th October when irrigated plots began to out-yield the unirrigated. This also occurred in November and January, although by January second yields from both trials had fallen very low and picking was ended for the season.

Conclusion.—(a) Irrigation has not extended the second flush into December this season.

(b) The lack of any response to irrigation before October is interesting and seems to indicate that until the last month or two of the dry season, soil still retains sufficient moisture not to limit pyrethrum yield. This may explain the lack of response to mulch treatments in the dry season in other trials.

DABAGA SPACING × PHOSPHATE EXPERIMENT—SECOND SEASON

This experiment was laid down and planted to a 3×2 factorial design on 4th March, 1954. In its first year the phosphate treatments resulted in a significant increase in yield but there was no difference between spacing treatments. This season the trial has yielded well and phosphate treatments have increased yields again.

TABLE X

DABAGA PHOSPHATE × SPACING TRIAL—MEAN TREATMENT YIELDS—LB. OF DRY FLOWERS PER ACRE

Treatment	Yields 1955	Total 1954/55
No superphosphate	487.0	545.4
150 lb. superphosphate per acre	563.8	641.5
300 lb. superphosphate per acre	589.8	667.9
Significant difference at 5 per cent P.	66.1	72.7
6 inches spacing	569.9	643.8
12 inches spacing	Not Significant	Not Significant
Standard error of single	12.7%	12.4%

Conclusion.—This season an application of 150 lb. superphosphate per acre has given an increase of 76.8 lb. of dry flowers per acre (significant at 5 per cent point of probability), and over the total yield of the two seasons an increase of 96.1 lb. per acre. The 300 lb. level of application has however resulted in no further increase. There is no evidence to show from this experiment that there is any difference in yield per acre from plants at 6 inches or 12 inches spacing. There is however an indication in the figures that 6 inches spacing may be slightly preferable.

ROCK PHOSPHATE TRIAL—SECOND SEASON

Planted in January 1954 to a 5×5 Latin square design, this trial has tested the effects of rock phosphate application, with, and without superphosphate. In neither season has the phosphate given a significant response, but since the trial was reasonably accurate the yield figures are included. In view, however, of the current successes with hyperphosphate it is unlikely that farmers will be interested in other, less reliable, forms of rock phosphate.

ROCK PHOSPHATE TRIAL—MEAN TREATMENT YIELDS—LB. OF DRY FLOWERS PER ACRE

Treatment	Yields 1955	Total 1954/55
No fertilizer	185.3	273.5
100 lb./acre rock phosphate	214.2	336.1
200 lb./acre rock phosphate	212.5	317.8
50 lb./acre superphosphate	204.0	319.3
100 lb./acre rock phosphate		
100 lb./acre rock phosphate		
100 lb./acre superphosphate	221.0	333.8
100 lb./acre superphosphate	15.2%	9.0%
Standard error of a single plot		

MULCHING TRIAL—SECOND SEASON

This trial was laid down on pyrethrum planted in 1953. In 1954 the mulch treatment was applied and resulted in a yield increase of over 100 lb. per acre.

This season the mulch was replenished and the trial continued: no response however was given. There are two factors which may have a bearing on this:—

(a) 1954 was an unusually dry season, whereas in 1955 rainfall was good, especially in the later part of the rainy season.

(b) The irrigation trial has shown that in the 1955 season pyrethrum required no additional moisture until October.

These results suggest that in a rather dry season pyrethrum might derive benefit from the mulch early in the year. This trial was fully commented upon in last year's report, and there is nothing further to add.

MULCHING TRIAL—MEAN TREATMENT YIELDS—LB. OF DRY FLOWERS PER ACRE

Treatment	1954	1955	Total
Mulched	513.7	318.1	831.8
Not mulched	406.4	288.4	694.8
Significant difference at 5 per cent point	100.0	N.S.	
Standard error of single plot	12.3 %	14.0 %	

ACKNOWLEDGMENTS

The writer wishes to acknowledge the considerable help and co-operation given by all farmers who have run experiments on their farms this season. Their interest in research into pyrethrum cultivation is unabated and a constant inspiration to anyone working with them.

J. R. TUCKETT,
Agricultural Officer

COAST AGRICULTURAL STATION, CHAMBEZI ANNUAL REPORT 1955

INTRODUCTION

Frequent changes in the senior staff of the station had a somewhat adverse effect on the continuity of work but nevertheless much was achieved during the year. The area under old palms was kept clean as also was the 180 acres under new palms. Twelve acres of Southern Province cashew were planted, and a start made on cleaning the bush on the eastern block of the station. A new copra kiln was built; an implement shed erected; and the building of a Guest House was well advanced by the year's close. Six pickings of coconuts were carried out as opposed to the usual four, and sixty-five tons of copra produced. The revenue of the station was more than double that of 1953.

The picture might well have been better still if the heavy rain in April and May had not water-logged much of the station, impeded work, and ruined one or two trials. Chambezi is now nearly ready to undertake its true function as a Coastal Research Station.

STAFF

At the start of the year Mr. J. S. Gunn was Agricultural Officer i/c, with Mr. Shepherd, Field Officer (Agriculture) as his assistant.

On 29th January, 1955, Mr. D. V. Chambers took over the station from Mr. J. S. Gunn.

On 15th August, 1955, Mr. D. V. Chambers left on transfer and was replaced by Mr. D. C. Randall, Field Officer (Agriculture).

At the beginning of November both Mr. D. C. Randall and Mr. Shepherd left the station and Mr. J. V. Webdale took over as Agricultural Officer i/c.

WEATHER

The main meteorological feature of 1955 was the extremely heavy rain experienced during April and May. The rainfall in these two months was nearly half the annual total, and caused severe flooding over the whole station with the exception of the 100 acres of high-ground on the western boundary.

Rainfall statistics for the year were:—

Month	Inches	Days	Bagamoyo Average Inches
January	2.68	6	3.7
February	7.54	8	2.61
March	7.75	4	4.07
April	12.74	21	9.14
May	11.83	20	7.51
June	2.56	11	1.53
July	1.38	.7	1.27
August	0.74	3	1.16
September	0.07	3	1.02
October	0.11	2	1.28
November	3.00	4	3.16
December	3.09	4	4.12
	50.49	93	40.34

COCONUT PLANTATIONS

All gaps in the blocks of mature palms were marked and hole digging carried out during February and March. In April in-filling of these areas was done.

Throughout the year dead palms were felled and buried as and when necessary.

Bush fires again menaced the station during 1955 and several broke across the Eastern boundary causing superficial damage to a number of trees before being brought under control.

Production figures for 1955 were:—

No. of nuts picked	447,962
No. of nuts used for seed	19,096
No. of nuts husked	418,770
Empty Husks and losses from various causes ...	3,798
No. sold as nuts and issued as rations	6,726
No. converted into copra	411,300

Copra.—Efforts were made during the year to improve the standard of copra produced on the station. To this end the following was done:—

1. Matting was hung over the end and the gate of the coconut store for shade to prevent splitting of nuts in store.
2. The arrangement of shells used for fuel in the kilns was changed to reduce smoking.
3. Matting was hung over the sides of the Gombero type kiln to exclude draft from the drying tray.
4. A reserve of unhusked nuts was maintained to allow sufficient maturing of nuts before husking.

These minor alterations seem to have had the desired effect and in the last few months of the year the so-called Grade II copra produced on the station was obtaining the same price as the Grade I.

During the year a disposal pit was dug in the vicinity of the kilns in which all husks were burnt—there being at the time a large accumulation of husks lying about. The ash was used in the nurseries.

With the heavy yield of nuts experienced at the start of the year it became evident that the single Gombero type kiln—holding 7,000 nuts at a time—was insufficient for our purposes. A second native type kiln—holding 3,000 nuts—was therefore erected. With these two kilns it is now possible to convert up to 60,000 nuts per month into copra.

Copra statistics for the year were as follows:—

Copra made	=	145,646 lb.
Copra sold	=	143,898 „
	=	3,997 frasilas
	=	64 tons
Value	=	70,220/-
Less commission	=	68,870/-
Average price per ton... ..	=	£53.16.0
Out-turn:		
Nuts per ton of copra sold	=	6,426
Nuts per frasila of copra sold	=	102.9

PRODUCTION OF COCONUT SEEDLINGS

Selection of seed from recorded palms was continued during 1955. The basis of selection of seed, however, was changed from palms yielding 150 nuts or more in the season 1952/53, to palms averaging 100 or more nuts during the two years 1952/54. It was found that the former basis did not produce sufficient seed for

our requirements since seeds exhibiting *Pseudotheraptus* damage were discarded. Although the new system would at first sight appear to be lowering the standard of selection, the fact that two years' records instead of a single season are employed gives a better indication of consistently high yielding mother palms.

Two thousand and fifty seedlings from the nurseries were used for in-filling in the mature palm blocks during April, and 6,129 seedlings were sold for a total of Shs. 2,915/-. Seventeen thousand, one hundred and twenty-five seeds were planted in the nurseries during the first half of the year.

REVENUE

Revenue for the calendar year 1955 was Shs. 76,498 74cts. This compares favourably with previous years which were—

Shs. 28,766 38cts. in 1952;
Shs. 36,077 24 cts. in 1953; and
Shs. 48,864 51cts. in 1954.

The sources of revenue are itemized below:—

	Shs.	cts.
Sale of copra	68,870	00
Sale of coconuts	796	25
Sale of coconut seedlings	2,915	10
Sale of other produce	2,237	01
Sale of eggs and poultry	1,608	28
Miscellaneous... ..	100	10
Total	76,498	74

EXPERIMENTAL WORK

(a) *Coconuts*.—The method of establishment (inter-cropping) trial was severely affected by the heavy rain in April and May and became completely waterlogged. All the palms yellowed, and some died; the cassava in the perennial cropping plots rotted; and the *Crotalaria* in the annual plots died. As a result the trial was somewhat modified in that the cassava was planted on ridges, and the annual cropping treatment followed by grass, was replaced by continuous grass cropping.

The other two coconut experiments were continued with treatments repeated where appropriate. The palms in both these experiments are growing well but to date there is no apparent difference between palms of different treatments.

(b) *Cashew Nuts*.—The Entomologist continued his investigation on the station into the control of helopeltis on both the Portuguese East Africa and Zanzibar cashew nuts. The damage caused by helopeltis on these trees was severe, and in one untreated block of the Portuguese East trees no nuts were harvested whatsoever.

(c) *Hibiscus*.—Observational plots were planted with H.O. Nos. 23, 24, 25 and 26 and a large plot of *H. cannabinus* (Laos) planted for retting tests. Germination and growth was satisfactory.

(d) *Pineapples*.—The two fertilizer/mulch pineapple experiments were continued with treatments repeated where appropriate. At the close of the year it was noticeable that those plots having a mulch were much the healthiest looking, whilst on the plants having mulch and application of nitrogen some fruits had started to form.

(e) *Cassava*.—The variety trial laid down in November, 1954, was abandoned owing to the heavy incidence of mosaic. A new cassava trial was laid down in November, 1955, using 25 varieties of cassava which had been selected for their mosaic resistance in trials at Mlingano, near Tanga. This trial is to see whether they maintain their resistance on the coastal sands here. To date growth is excellent.

(f) *Rice*.—Observational plots of eight local varieties were planted. These plots were harvested June/July and data concerning yield, tillering capacity, grain and plant characteristics, and suitability to local conditions were noted.

(g) *Sorghum*.—The trials to test residual manurial value and response to direct fertilizer applications of white sorghum failed due to a combination of poor seed, impoverished soil and excessive moisture.

FOOD CROPS

Six acres were planted up with Afaa and Kahogo paddy and two acres with cowpeas. Both crops yielded well and were harvested for rations. Ten acres were planted with maize but due to waterlogging yielded but two bags of indifferent quality. Groundnuts and sunflower were also planted in two small areas but failed miserably.

LIVESTOCK

(a) *Poultry*.—At the commencement of the year there were 102 birds (White Leghorns, Rhode Island Red, and WL×RIR). Forty of these birds were cockerels and were sold during the year; sixteen failed to survive an unwarranted attack by bees in November; six birds were sent to the Agricultural Officer, Morogoro; and three died of snake bite. At the year's close there were 37 adult birds left. There were two outbreaks of coccidiosis amongst the young stock in 1955 and thirteen died in spite of being treated with Embazin. Eggs produced during the year totalled 5,392.

(b) *Cattle*.—The herd numbered 27 (2 bulls, 25 cows) at the start of 1955 but suffered severe losses during the rains. From March to June 8 cows and 1 bull died—mostly from Red Water and Trypanosomiasis. Blood slides of the herd taken in June showed that all the cows with one exception were positive for Red water and eleven positive for Trypanosomiasis (*T. vivax* and *T. congolense* both being present).

From June onwards the health of the herd improved steadily and only one cow died (of trypanosomiasis) during the second half of the year. Four calves were born in the latter half of 1955.

(c) *Donkeys*.—Fourteen donkeys were received from Dodoma in September. All have remained in excellent health.

BUILDINGS

The main work during 1955 consisted of the construction of a native type copra kiln, the erection of an implement shed, and the building of a Guest House.

J. V. WEBDALE,
Agricultural Officer in Charge

SUMMARY OF THE ANNUAL REPORT OF MWANHALA EXPERIMENTAL STATION, WESTERN PROVINCE, FOR THE YEAR 1955

WEATHER

The total rainfall for the 1954/55 season was 29.2 inches, rather lower than the average and its distribution was fairly satisfactory except for a fortnights drought in January.

FALLOW MANURIAL TRIAL

In the continuous cultivation section of this experiment, yields of sorghum and groundnuts were poor and showed no direct or residual responses to 3 tons of manure or 100 lb. of single superphosphate.

PURE VERSUS MIXED CROPPING TRIAL

Maize, sorghum and groundnuts in pure stands were compared with several combinations as below.

				Yields lb./acre		Revenue Shs./acre
Maize	...	...	...	1,188	...	216
Groundnuts	...	...	...	475	...	194
Sorghum	...	...	...	352	...	48
Groundnuts and Sorghum				522	}	255
				334		
Groundnuts and Maize				317	}	333
				1,109		
Groundnuts and	...			334	}	263
Maize and	...	...	...	590		
Sorghum	...	...	...	149	}	61
Significant differences 5 per cent				—		
Significant differences 1 per cent				—	...	80
						Shs.
Groundnuts	...	...	...	0/90	per kilo	
Maize	...	...	...	0/35	„ „	
Sorghum	...	...	...	0/30	„ „	

Sorghum stands were poor on account of Central-shoot fly. At the populations achieved in this experiment mixed cropping gave higher financial returns than pure stands.

TIME AND PLANTING AND CULTIVATION TRIAL

		Groundnuts in lb./acre			
Planting Date		9th December	11th January	8th February	Mean
Flat	...	625	552	222	464
Ridged	...	592	156	92	279
Tie-ridged	...	592	156	103	284
Mean	...	603	288	139	—
		Maize lb./acre			
Flat	...	387	231	317	308
Ridged	...	757	422	339	508
Tie-ridged	...	605	634	433	558
Mean	...	583	429	363	—

At the early date of planting flat cultivation was not superior to either type of ridging but was markedly so at the two later dates. Plant populations were about three times as great on the flat cultivation. In the early planting the plants

had sufficient time to effect maximum spread and so compensate for lack of numbers. The value of early planting for both maize and groundnuts is clearly shown. Both types of ridging gave appreciably higher yields of maize than flat cultivation.

<i>Rice—Method of Planting</i>				Yield
				lb./acre
Broadcast	...	...	...	1,795
Pregerminated	...	...	...	1,707
Transplanted	...	...	...	1,602

The treatment differences are not significant and the results agree fairly well with those obtained in previous years. If adequate water is available early in the season and weed control is not a serious problem, broadcasting has much to commend it. Labour requirements are less and larger acreages can be cultivated. If water supply is low early in the season and/or, weed growth difficult to control transplanting will still produce yields as good as those obtained from broadcasting.

RICE VARIETY TRIAL

In a variety trial comparing eighteen varieties with Kahogo none were significantly better than Kahogo but five yielded significantly less.

SUMMARY OF THE ANNUAL REPORT OF MAHIWA EXPERIMENTAL STATION FOR THE YEAR 1955

GENERAL

The paddy dams were laid out on a rotational plan to give three years paddy and two years fallow. Crops were good, an average yield of 2,658 lb. per acre being obtained. Sorghum, sunflower and maize crops were poor. Sesame was protected from flea beetle attack and yielded 360 lb. per acre. Groundnuts gave a fair yield though the percentage of "pops" was high. Rosette disease was almost non-existent. The main tree crop has been oil palm and seedlings have been raised for distribution.

Surplus cattle have been sold off and there has been a great demand for young bulls and heifers in calf. There has been only one case of trypanosomiasis but some tick-borne diseases.

The application of sulphate of ammonia gave increased yields of sesame, sunflower and groundnuts. Sorghum did not show any responses to sulphate of ammonia, phosphate, muriate of potash and farmyard manure nor to treatment with Agrosan seed dressing. Yields of cassava were highest at 15 months after planting, lower at 18 and 21 months and decreased considerably at 24 and 30 months.

Sesame did not respond to phosphate or farmyard manure. The oil palm variety Pedigree yields much better than Deli.

SUMMARY OF EXPERIMENTAL WORK, LAKE PROVINCE, 1955

(A).—EAST LAKE DIVISION

1. *E.A.A.F.R.O. Type Fertilizer Experiments*.—Four of the five fertilizer experiments were continued: at Illangala, Ukerewe (cotton), Ushashi, Musoma (cotton), Inchage, North Mara (maize), and Tarime, North Mara (maize).

This was the second year and the results show the residual effect of various fertilizers and manurial dressings applied in 1954.

Dressings were as under:—

Nitrogen (N) = Sulphate of Ammonia @ 1 cwt./acre.
Phosphate (P) = Superphosphate @ 1 cwt./acre.
F.Y.M. @ 5 tons/acre.

Results for the two years were as follows, all yields being in lb. per acre:—

FIRST YEAR EFFECTS OF FERTILIZER AND MANURE

Plot	F.Y.M.	N & P	N	P	Control
Illangala (cotton)	1,058	1,178	1,037	923	845
Ushashi (bulrush millet)	1,673	2,562	2,723	1,876	1,659
Inchage (finger millet)	616	427	427	483	329
Tarime (maize)	2,786	2,723	2,156	2,135	2,030

SECOND YEAR RESIDUAL EFFECTS

Illangala (cotton)	570	487	515	423	460
Ushashi (cotton)	1,968	1,636	1,775	1,775	1,586
Inchage (maize)	2,575	2,333	1,055	1,667	1,539
Tarime (maize)	2,197	2,013	2,081	2,120	2,168

These results have not been statistically analyzed as yet and it is therefore difficult to draw conclusions. One factor common to all crops on all plots is the considerable residual value of F.Y.M. Of the residual fertilizer effects probably only that to N & P on maize at Inchage is significant.

2. *Paddy*.—Trials were carried out in Ukerewe and Musoma to ascertain whether the popular prejudice against “Kahogo” rice due to its low yields is justified or not. Results were as under (lb./acre) plots being 7 yards × 7 yards:—

Ukerewe	Variety “Ajaya”	Variety “Kahogo”
Plot 1	4,802	3,136
Plot 2	3,822	2,940
Plot 3	4,116	2,352
Plot 4	4,508	2,670

With a difference in price of 2 cents per lb.—providing these results are typical—it is obvious why there is such reluctance to grow Kahogo in the East Lake area.

Musoma (Zanaki).—An experiment was continued to ascertain whether a good crop of paddy can be grown by irrigation from the small water supply available below the usual two to three million gallon type hand-built dams. The crop thrived remarkably well and yielded on an average 2,166 lb./acre. At the same time a varietal trial was carried out using five of the best varieties obtained from Botanist, Ukiriguru. Detailed results were as under:—

Variety	Yield in lb./acre
Kahogo	1,742
9/235 ex-Sindano	1,691
9/82 ex-Chirukanga	2,772
0/659 ex-Maji-Maji	2,748
0/602 ex-Sindano	1,842

All the plots were planted in mid-November, transplanted mid-January and harvested early June.

3. Varietal Trials—Bulrush millet (Nyahatende)—

Variety	Yields lb./acre
Local Type	4
A.E. Zunzuriga	140
E.M. I. M.138	120
E. M. Many	150

It is thought that the slowness of maturity was the cause of the local variety's failure to yield.

4. Sorghum Varietal Trials (Nyahatende)—

Variety	Yield lb./acre
Enyanza	268
Kano	224
Suk I	208 (damaged by Smut)
S.B. 116 Shallu	104
Local type	326

Throughout the growing period the new varieties, particularly Suk I, were well in the lead and their speed of maturity was remarkable. The local variety took much longer to mature but yielded more heavily. The comparatively low yields may be accounted for by the poor soil ("imbambasi" type) together with shortage or rain. Similar plots were planted at Tarime and Kinesi, but were eaten by birds.

5. Time of planting cotton trials (Nyahatende)—

Date of Planting	Yield lb./acre
10/12/54	420
21/12/54	294
31/12/54	37
10/1/55	37

The value of early planting is evident.

6. Cowpea Varietal Trials—

Variety	Yield lb./acre
B.L. Ogden	176
B.L. Yellow	176
B.L. Tambara	264
B.L. Kwajisi	264
Local Type	264
B.L. Turian	352
B.L. Lincot	165
Ex-Morogoro	324
Mwibara	286

Variety ex-Morogoro and B. L. Turian have now given good results for three years running and might well be worth further multiplication.

7. Cultivation Experiment.—Demonstration plots were planted at Nyahatende comparing tie-ridged and non-tie-ridged land. The results clearly showed once again the advantage of tie-ridging (Bulrush millet).

	lb./acre
Plot 1 unridged	750
tie-ridged	900
Plot 2 unridged	492
tie-ridged	444
Plot 3 unridged	444
tie-ridged	612

8. *Cassava Demonstration Trials*.—Comparison between the Mosaic resistant “Msitu Zanzibar” with local types. Nyahatende is a particularly bad place for Mosaic disease and the results reflected this:

					Yield lb./acre
Local Cassava	...	...	...	...	2,400
Msitu Zanzibar	...	...	...	...	3,240

9. *Grassland Trial—North Mara*.—This trial continues. Fencing has been repaired and the sowing of Rhodes Grass on plot 9 took place in April. Unfortunately, much of the seed was damaged by ants and germination was poor. During the remainder of the year, grazing was carried out according to schedule except for short periods in April and August when foot and mouth disease occurred. Another slight mishap occurred in August when plots 1 and 10 were partially burnt, but generally speaking, the trial has been managed much more successfully this year than previously.

10. *Wheat Trials*.—An acre of bearded wheat, variety 261-S, was planted at Tarime. The seed rate was 120 lb. per acre which only produced 415 lb. yield. Plantings of varieties 184 P and 261 R in observation plots were also made.

11. *Dusted v. undusted cotton seed trial (Illangala)*.—Results to date, lb./acre using “Perenox”:

				1954	1955
Treated seed	...	...	...	375	552
Untreated seed	...	...	...	337	438

(B).—WEST LAKE DIVISION

1. *Mixed Cropping Experiment (Biharamulo)*.—The object of the experiment has been to ascertain the differences in yield to be obtained from Cassava, Sweet Potatoes and Groundnuts, either planted separately or mixed, as is the local custom. The sweet potatoes and groundnuts were harvested in July and the cassava is to be harvested during the coming dry season. It would appear from the results that the only real significant difference lies in the degree of fertility of the area selected, of which there were three. Sweet potatoes gave almost double the yield in one place when mixed with other crops, whereas at another, the reverse was the case. Plot sizes were: Mixed, 1 plot of quarter acre, unmixed, 3 of one-twelfth acre, and detailed results were as under:—

				Mixed			Unmixed		
				Groundnuts	Sweet Potatoes		Groundnuts	Sweet Potatoes	
Nyarubungo	...	...	...	9 kgs.	92 kgs.	...	9 kgs.	...	47 kgs.
Kalenge	...	...	...	35 ”	365 ”	...	31 ”	...	387 ”
Nyakahura	...	...	...	1½ ”	9½ ”	...	1 ”	...	17 ”

2. *Coffee Pruning Experiment (Ngara)*.—The multiple v. single stem pruning has continued for a further year. Results to date (though harvesting is incomplete) give 2 lb. 2 ozs. per tree for multi-stem and 1 lb. 12 oz. for single stem.

3. *Coffee Shade Experiment (Ruganzo)*.—Started in the Ruganzo Settlement Scheme, it follows the observational plot technique and consists of three treatments: the first contains coffee without shade, the second has banana shade and third starts with banana shade, eventually giving way to tree shade.

A broad-leaved member of the *Ficus* spp. is being used for the tree shade and it is hoped to establish similar sites at other place within the district. Each observation plot is ¼ acre.

(C).—SUKUMALAND SOUTH

1. *Fertilizer Field Trials on African-grown cotton*.—Initially, 256 fields were selected and phosphate applied at the rate of 90 lb./acre before throwing up the ridges. By February, only 156 remained, the rest having been discarded for one reason or another.

Sulphate of Ammonia was then applied at the rate of 200 lb./acre to one half of each plot on the ridge. Instructors ensured that the owners of each experimental plot planted a sufficient area of cotton outside the plot to serve as a control. Ideally, these areas should have been planted at the same time as the experiment, but this was not always the case. By May, 1955, 125 plots were finally selected for results. A harvest area 20 feet $\times$ 20 feet was selected for uniformity in each plot: this undoubtedly led to unconscious bias on the part of the selector, giving rise to considerable sampling errors, and in future the control plot will be contained within the experimental area.

Rainfall over the growing season was estimated at 25 inches and results are tabulated below:

Results:—

(a)

Total No. shambas	Yields of control	P Effect of	N Effect of by subtraction	Significant Difference	S.E.
125	335	+ 145	+ 109	53	18

All in lb./acre.

(b) Effect of fertilizer in increasing yield in pounds per acre grouped by control yields.

Control Yield	No. of shambas	P	N.P.	N by subtraction
Under 300	44	+ 127	+ 216	+ 89
300-400	41	+ 162	+ 242	+ 80
400-500	40	+ 144	+ 321	+ 177

From the results obtained it appears that both N and P give a substantial increase in yield. Low yields on many of the plots may be attributable to termite damage particularly on the red soils.

2. *E.A.A.F.R.O. Type Legume Trial results in lb./acre of Bulrush Millet.*

Control	N	P	NP	FYM	S.E.	Significant Difference (0.05)
310	+ 1	— 13	+ 43	+ 32	16.94	50.75

These results are far from good: termite damage caused a very uneven stand. No treatment is significant, and NP and FYM are the only two which produce an increase in yield.

3. *E.A.A.F.R.O. Nunghu Trial Results in lb./acre of Bulrush Millet.*

Control	N	P	NP	FYM	S.E.	Significant Difference (0.05)
352	— 48	+ 90	+ 24	+ 209	19.37	58.07

P and FYM appear highly significant, N, on the other hand, has a decided lowering effect on yield.

NOTES ON EXPERIMENTS CARRIED OUT IN THE NORTHERN PROVINCE, 1955

Experimental work in the Northern Province can be broadly classified into two categories.

(a) Research into certain basic aspects of soil fertility mostly carried out at Tengeru, and

(b) Agronomic research, mostly carried out by district officers, and dealing with the testing of different crop varieties, method of cultivation, pest control and similar aspects of practical farm work.

Crop Trials.

WHEAT

Wheat Variety trials—comprising a series of wheats provided by the Senior Plant Breeder, Department of Agriculture, Kenya—were set out in the wheat growing areas of Moshi and Mbulu districts. The main object of these trials, apart from obtaining yield data, was to test the resistance of the various varieties to the current races of stem rust. Some selections (based on an original selection No. 367) showed some resistance to rust (Race K.14, which is highly damaging, was most prevalent this year) and where the attack was not too severe yielded well at about 9 bags/acre, which was slightly higher than the control variety, W.1. Where rust was severe, however, all varieties were affected. Those which showed most resistance were, generally speaking, too long maturing for the wheat growing areas in this province. On bulk trial plots at Olmolog, 360 H appeared fairly promising (but rather late) and 1066, while fairly rust resistant, is too long maturing for general use. In Arusha in spite of its susceptibilities to rust the well established variety 261/R proved superior to all others tried. The varieties 261R and W.1 have, with 294, formed a very large proportion of the wheat acreage in the Northern Province during the past few years and although these varieties are all susceptible to the rust races which are now prevalent no other variety has as yet been produced which can satisfactorily replace them, particularly in the lower wheat growing areas.

MAIZE

A series of variety trials was carried out in various parts of Arusha and Moshi districts using the following varieties:

Local White.

Botman (an early maturing white originally brought from S. Africa).

Italian Red (an early maturing yellow originally imported from Italy).

Ekstein (a yellow maize obtained from Ilonga Experiment Station).

Kongwa Red (a yellow maize obtained originally from the O.F.C., Kongwa).

Early Pearl (a white maize originally brought from S. Africa).

None of these varieties can be regarded as absolutely pure but they are all fairly distinct. In Arusha the variety trials were combined with time of planting trials and in all such trials the local white proved as good as any of the other types. These trials, however, were sited in very favourable areas. In Moshi District the

trials were sited in some of the lower and drier areas into which maize cultivation has only recently spread and here the local white showed up very badly. The following data were obtained from one formal yield trial.

<i>Variety</i>					Days to maturity	Yield Bags/acre
Local White	...	...	...	...	164 ...	2.3
Ekstein	...	...	...	...	164 ...	5.2
Botman	...	...	...	...	130 ...	7.0
Kongwa Red	...	...	...	...	130 ...	6.4
Italian Red	...	...	...	...	120 ...	6.1
Early Pearl	...	...	...	...	130 ...	5.8
Sign. Diff. $P = .05$	...	...	...	...	...	1.8

An interesting observation in this trial was that the local white variety was more resistant than any other to white ant attack which considerably reduced the plant population in the plots of the other varieties particularly of Ekstein.

An experiment comparing the yields of maize planted on the flat, on ridges and on tied ridges gave some indication that ridging, whether tied or not, gave an increase in yield, but varying plant populations in the different treatments rather obscured the result.

Experiments carried out at Mbulu on the thinning of maize, on manuring, and on control of stalk borer failed to give any results, due to drought. Dusting with D.D.T. for control of stalk borer showed good control in the early stages of growth but subsequent movement of larvæ from adjacent untreated plots resulted eventually in almost as much infestation in treated plots as in the control.

In an experiment at Arusha Chini in Moshi District on the irrigation of maize, irrigation sufficient to make up the total supply of water to various levels equivalent to between $1\frac{1}{4}$ inches and 2 inches of rain per fortnight was applied. All irrigated plots showed increases in yield but there were no significant differences between the different rates of water supplied.

Various observation plots of maize in the lower areas of Moshi District indicated that excellent crops can be obtained with a little supplementary irrigation, but that the local white variety (which is "indigenous" to the higher rainfall areas in the shamba belt just below the coffee and banana zone) is probably not suited to the lower altitudes and could with advantage be substituted by e.g. Kongwa Red which at Uru Chini yielded 12 bags/acre.

COTTON

Various observation plots of cotton were planted in the lower areas of Moshi District mostly with some supplementary irrigation. A comparison of flat and ridge cultivation under irrigation gave some indication in the early stages of growth that ridge cultivation was superior but any difference was not marked in the later stages of growth and the flat plot in fact yielded considerably more than did the ridged plot. Growth of cotton in all areas was excellent but stainers were a major problem especially when there was a considerable amount of uncleared land in the vicinity and yields were disappointing, mainly due to stainer damage, amounting to between 500 lb. and 1,000 lb. of seed cotton per acre. Unirrigated cotton in similar areas yielded very poorly, but it was noticeable that stainer damage on unirrigated plots was much less.

A formal irrigation trial was carried out at Arusha Chini where water was applied in quantities sufficient to bring the total received by the plants up to the equivalent of 1 inch, $1\frac{1}{4}$ inches, $1\frac{1}{2}$ inches and $1\frac{3}{4}$ inches of rain every fortnight. Irrigation increased the yields over the control plots and in general increasing rates of irrigation gave increased yields of cotton.

MISCELLANEOUS

Trials were carried out with Potatoes, Haricot Beans, Simsim, Pyrethrum, Lima Beans and Sorghum in Moshi District. Short term sorghums grew well enough in the lower areas (although Central Shoot Fly badly attacked one plot) but birds are extremely damaging and in many cases yields were no better than maize yields. Sorghum cannot really be considered a suitable crop for the area.

A trial plot of pyrethrum at Nanjara in Rhombo division of Moshi, on a site which is definitely at the lower edge of the possible pyrethrum zone survived a very dry season from May till November and at the end of the year was in a very good state indeed. Between June, when picking first started, and December it yielded at the rate of 360 lb./acre of dried flowers with a pyrethrin content varying from 2.7 per cent (June picking) to 1.68 per cent (November picking).

SOIL FERTILITY TRIALS

Three experiments, one at Oljoro and two at Tengeru, now in their third season, are designed to follow the trend of maize yields for five years following on the breaking from (a) virgin grassland (b) a Rhodes grass ley (c) secondary grass/bush. The results from the virgin grass site, which again suffered this year from acute drought, confirmed previous years' results to a certain degree in that the total weight of stover in the first year after breaking was significantly less than in the second and third years after breaking. This "first year effect" was more marked if the maize is closely spaced. These effects were not significantly shown up in the yield of grain which was, however, very poor. Wider planting and the application of sulphate of ammonia both of which increased yields in the second and third years had much less effect in the first year, again in general confirming previous results which show that the "first year effect" is very difficult to counter-balance. No significant results were obtained this year from the other two experiments.

A trial laid down to test the effect on maize yields of the previous seasons soil management yielded interesting if negative results. Four treatments were carried out in 1954 on a 4×4 latin square as follows:

- (a) Clean fallow—plots kept free of weed growth by regular hoeing.
- (b) Dirty fallow—no hoeing, weeds allowed to grow freely.
- (c) *Crotalaria* sp.—grown as a green manure and dug in.
- (d) Maize.

Maize had been grown on the plot for several years previously. Soil nitrate determinations were made from late 1954 throughout the following year and showed that in general No. 3 was highest in the *Crotalaria* plots, with the clean fallow and maize plots next and the dirty fallow plots considerably lower. The highest concentration on all plots occurred in late March 1955 soon after the start of the long rains and about a fortnight after all plots had been planted with maize. The yields of maize in 1955 following on the various treatments in 1954 were:

	lb. grain/acre
After clean fallow	2,200
After dirty fallow	2,699
After <i>Crotalaria</i> as a green manure	2,110
After maize	2,178

The differences are not significant but the higher yield after a dirty fallow on plots with a markedly lower No. 3 content is difficult to explain but is in accordance with the beneficial effects noted elsewhere following on "tumbledown" fallows. It was also noticeable that the yields on the "dirty fallow" plots were much more uniform than on the other plots.

Experiments on the effect on maize yields of different types of mulch, initiated in previous years, were continued in 1955. It was confirmed that an "inert" mulch of Kavirondo matting gave an increase in yield as compared with no mulch, while a mulch of maize stover had an obvious initial depressing effect but ultimately resulted in yields of the same order as the control. Contrary to previous years results buried stover resulted in a significant increase in yield in one experiment but in the "Broadbalk" experiment referred to below burying stover in some cases resulted in a depression of yield. The time of incorporation of stover in relation to the season and the time of sowing of the subsequent crop appear to determine whether or not it will have a beneficial or deleterious effect. Nitrate determination throughout the season showed that nitrate under the inert mulch of Kavirondo matting was always much lower than that under either a surface mulch of maize stover, or under no mulch, while buried stover, contrary to expectations, resulted in a high nitrate content in the soil. As in the experiment referred to above, the highest yields (from the Kavirondo matting plots) were obtained from plots showing the lowest nitrate content. No adequate explanation can be offered for these various effects, which only indicate our general ignorance of the nitrogen balance in tropical soils.

A "Broadbalk" experiment in which maize will be grown continuously under various treatments gave its third year's results in 1955. As in previous years inorganic nitrogen in the form of sulphate of ammonia gave a highly significant increase in yield while farmyard manure, although it did increase the yield somewhat, did not do so significantly. A marked feature of this year's results was a significant depression in yield from the application of superphosphate whether by itself or combined with sulphate of ammonia. This effect has occasionally been recorded in other fertilizer trials in Arusha District. This year for the first time the plots were split for a comparison of the effect of digging in the stover versus removing it. As mentioned above incorporation of the stover in the soil significantly reduced yields in the control plots and in those on which farmyard manure was applied.

NOTES ON EXPERIMENTS CARRIED OUT IN THE TANGA PROVINCE, 1955

KUNGULUI FARM

The potato variety 1521 c(3) remained free of *Phytophthora infestans* (Irish Blight) for the thirteenth successive planting since its importation. It has given the third highest average yield of all the many varieties that have been tested during the past ten years and is the highest yielder of those which have been proved blight-proof. As it is also palatable by both African and European standards, active steps are now being taken to bulk up seed for planting in Lushoto District, which supplies the rest of the Tanga Province with potatoes, grown in small African gardens.

It was found that planting potatoes, variety 1521 c(3), on top of manure in shallow trenches and gradually earthing up as the plants grew, not only gave higher yields, 10.5 tons as against 6.6 tons per acre for the usual method of planting them in a hole made in the top of an already prepared ridge but also prevented large losses from sun-scorch in dry seasons.

Four varieties of Sweet Potato, Bwaza, Iringa, Kwata and Mgeni, have yielded well over a period of four years.

USAMBARA PLAINS

In 1954 there were trial plots on thirteen sites but as it was considered that eight had served their purpose, by demonstrating for three years in succession that arable agriculture was not a practicable method of development of the surrounding areas, they were discontinued and further trials were only carried out on the five sites where economic returns might be hoped for. As the north-east part of the Handeni District seemed to offer more possibilities for settlement of people from the overcrowded areas in the Usambaras than any sizeable area within the boundary of Lushoto District, other than those where irrigation water is available, three new plots were opened there, one near Korogwe being supervised from Lushoto, and two nearer Handeni being supervised from Handeni. As in previous years these trial plots were designed primarily to provide basic data on the cropping potentialities of possible expansion areas.

From a more immediate standpoint the objects of the trials may be summarized as follows:—

(a) A continued comparison of the efficacy of ridged, tie-ridged, and flat cultivation for various crops on different soils and under varied climatic conditions.

(b) A comparison of the yield of different food and cash crops, and of different varieties, of maize, sorghum and cotton, under the varying soil and rainfall conditions to be found, either grown on rain alone or assisted by irrigation.

(c) A comparison of different varieties of cassava, both with regard to yield and resistance to virus diseases.

(d) Further trials to test the suitability of crops not at present grown in the area.

(e) A continuation of reclamation trials on saline soils at places where adequate irrigation water is available.

(f) A continuation of rice spacing trials, i.e. a comparison of present local methods with those which have been found to give increased yields in other places.

The general conclusions drawn are detailed below:—

(a) In the dry Mombo area ridging did not give better yields than flat cultivation. At Kwamdulu and Kamsala with higher rainfall than Mombo both ridging and tie-ridging gave better yields than flat cultivation particularly for maize and cotton.

TABLE I

The value of ridging and tie-ridging at three sites 1952–1955:—

Crop	Mombo			Kwamdulu			Kamsala		
	Flat	Ridged		Flat	Ridged	Tie-ridged	Flat	Ridged	Tie-ridged
Maize ...	716	658	...	944	1,176	1,291	440	948	968
Ground-nuts ...	660	880	...	624	—	852	816	—	768
Beans (various)	72	56	...	423	—	477	428	—	516
Cotton ...	238	220	...	478	696	839	850	1,370	1,450
Average Rainfall April–August	13.3			24.3			25.0		

(b) It was again found that the yellow “Katumbili” maize gave higher yields (approximately 140 lb. per acre, average of 13 trials) under conditions found on the plains than the white horse tooth types preferred by the Wasambaa. The sorghum variety S.133, bred by the Botanist at Ukiriguru, was again outstanding, giving a yield of nearly 2,800 lb. per acre at Mombo on a rainfall of less than 14 inches during the growing season.

Palatability tests were carried out on the seven sorghum varieties under trial, and as most of the people who ate them classified S.133 as excellent it would seem to be an ideal food crop for this area. Even in a year of reasonable rainfall on the plains groundnuts were again found to give a higher yield than beans. Cotton was again shown to be the most profitable cash crop for growing on the plains and in the cotton variety trials Ukiriguru-bred strains were again found to give higher yields than either Eastern Province (Ilonga) or Uganda (Namulonge) strains.

(c) Cassava trials showed that most of the Amani bred varieties are more resistant to mosaic virus disease than local varieties, though some of them give very poor yields. On the other hand the Amani variety 4723A/26 would seem to be outstanding, being both mosaic-resistant, palatable, and very high yielding, as sixteen months after planting it gave a calculated yield of 19 tons per acre, more than three times as high as any of the other twenty-one varieties on trial.

(d) Trials with new crops again showed that sunflower (approximately 1,000 lb. per acre) could profitably be grown on saline soils undergoing reclamation. Sorghum (1,000–1,500 lb. per acre) and groundnuts (1,500 lb. per acre) were again found more suitable crops than maize (600–1,000 lb. per acre) and beans in the areas of lower rainfall. “Texas Grano” onions have also been found a most promising crop for growing under irrigation in the dry season on reclaimed saline soils both to the north and east of the Usambara massif. (The yield of onions from a measured area of 85 square yards at Magoma was 264 lb., which works out at over 6½ tons per acre).

(e) Reclamation and irrigation trials have given encouraging results. At Magoma it was found that on the permeable soil type found there reclamation can be carried out in one year, even with drains spaced 200 feet apart. At

Mng'aro where the soil is less permeable it has been found that though good yields of salt-tolerant crops may be obtained in the first year it takes two years for the soil to become fully reclaimed and give good yields of crops with a low salt-tolerance, such as maize. At both sites mentioned above it was found that the returns of food crops or cash crops were sufficiently high to justify the high capital cost of digging the drains necessary for reclamation.

(f) Rice planted at 6 inches $\times$ 6 inches with one topped seedling per hole and at 12 inches $\times$ 12 inches with three topped seedlings per hole gave better yields than the spacing used locally about 18 inches $\times$ 18 inches with one untopped seedling per hole.

6 $\times$ 6 in. 940 12 $\times$ 12 in. 870 18 $\times$ 18 in. 670

Five tons of gypsum per acre applied in one instance in 1952 and another in 1953 increased the yield over all spacing by an average of about 260 lb. per acre. Similarly fifteen tons of sisal waste per acre gave an increase of about 180 lb. per acre.

COASTAL AREA

A series of trials to investigate various aspects of pineapple culture were carried out on the Native Authority farm at Burunge, near Muheza, and from the detailed results obtained the following general conclusions have been reached:—

(a) That manuring with a complete fertilizer mixture (N.P.K.) or with heavy dressings of nitrogen alone, gives noticeable increases in yield, but that potash manures are necessary for good flavour.

(b) Spraying with Perenox does not appear to have any effect on the condition known as brown rot. Ripening of fruit seems to have been delayed on the plots which were sprayed with Perenox.

(c) Hormone treatment for hastening of flowering, seems to prevent the plant forming suckers, and over a long period may have a depressing effect on yield. On the other hand it is definitely beneficial in promoting even harvesting.

(d) If the main object of a pineapple plot is the multiplication of planting material, it would seem advisable to fertilize it heavily but not to use a fruit inducing hormone. Very heavy applications of fertilizers of the order of 1 ton per acre, as used in other parts of the world, are found under Muheza conditions to produce fruit which are tasteless and too large for canning as rings, which is the highest priced type of canned fruit. Excessive use of fertilizers also leads to large numbers of double-headed and fasciated fruits, which is objectionable from the canning point of view, though not if the plots are being used for the multiplication of planting material, as all the heads from multiple-headed plants may be planted.

Trials on the control of Grey Leaf Spot (*Stemphyllium solani*) were carried out at Muheza using Tulisan and Dithane as recommended by the Plant Pathologist at fortnightly intervals. Dithane was found effective in controlling the disease but Tulisan seemed quite ineffective. Seven varieties of tomatoes imported by the Plant Pathologist from Hawaii, where they are claimed to be resistant to Grey Leaf Spot were tested at Muheza but were found to be even more susceptible to the disease than the local varieties. Some of each variety however were sprayed with Dithane and their seed will again be planted for trial in the coming year.

Varietal trials on mosaic-resistant cassava strains continued; yields of all varieties being lower on the coastal sands than on the red earths of the hinterland.

PARE DISTRICT

Trials to compare the yields of thirteen sorghum varieties obtained from the Botanist, Ukiriguru, with each other and with maize, which is the only crop at present planted by the Wapare in the arid plains below the mountains in spite of its partial or complete failure nine years out of ten, were again carried out at seven sites round the mountains and again showed that whereas sorghum will give a reasonable crop any place where the rainfall is five inches or over during the growing season, maize was once again an utter failure even when tie-ridged. A comparison of the calculated yield per acre of one sorghum variety (S.132) with that for maize, at the five sites for which reliable yield figures are available, is given hereunder as an illustration:—

Site	Location	Sorghum S.133		Local Maize	
		Ridged	Flat	Ridged	Flat
Kwakoa	... N.E.	1,092	252	Nil	Nil
Kiruru	... N.W.	588	714	Nil	Nil
Lembeni	... N.W.	252	Nil	Nil	Nil
Vudee	... S.W.	480	168	18	Nil
Mwembe	... W.	504	84	60	Nil

Irrigation and reclamation trials continued at two sites on the bank of the Pangani river where the climate is very arid. At Naururu, where the soil is a permeable sandy loam, good yields of all crops were obtained in this, the second year. Even Panicum millet, which is very salt-sensitive and is therefore used in these trials solely as a plant indicator of the saline content of the soil, yielded 814 lb. per acre. On this soil type the removal of the salt would appear to be both easy and economic, as sunflower, cotton and sorghum all gave better than average yields in the first year, and maize, groundnuts and beans have also given good yields in the second year. Onions are also growing well but have not yet been harvested. On the other hand, at Marwa, where the soil is a highly impermeable silty clay, saturated with sodium, the soil has not even yet begun to drain freely, with drains 100 feet apart, and yields are still poor, so that it seems doubtful whether reclamation of this soil type will ever be found economic, though it is potentially a richer soil being formed from volcanic silt from Kilimanjaro, whereas the Naururu soil 20 miles further south is derived from the local gneiss.

HANDENI DISTRICT

The pattern of experiments carried out on the Handeni Native Authority farm has been the same as during the previous three years, and from the detailed results obtained the following conclusions may be drawn:—

(a) In practically all cases, even with sorghum, contour ridge cultivation has given higher yields than flat cultivation.

(b) In the case of two sets of experiments, to investigate the effect of continuous cropping with the same crop, and to compare the effects with rotation of crops as well as to compare two different rotations with one another, the yields of more than half of the plots involved, including most of the continuous cropping ones, have been the highest recorded in any of the four years that the trials have been in progress, which would seem to indicate that rainfall distribution has more effect on yields in Handeni District than any other factor involved.

(c) A residual effect equivalent to some two bags of maize per acre has been found for the phosphate treatments of a factorial fertilizer experiment carried out three years ago (in 1953) for the East African Agricultural and Forestry Research Organization.

(d) Nothing conclusive emerged from a trial at this station of a number of different cotton varieties, using different spacings and methods of cultivation, unlike other sites to the east where Ukiriguru-bred varieties were found superior.

(e) Sorghum variety trials were again carried out and again Enyanza showed itself best suited to conditions as obtaining at Handeni, and multiplication of this variety for issue as seed will be continued.

(f) As maize had been found to give a response in yield to phosphate in the E.A.A.F.R.O. trial, a trial was made of using superphosphate on sorghum, without any success. In fact it seems to have depressed yields in the first year.